A STUDY OF PREVALENCE AND RISK FACTORS OF AMBLYOPIA IN SCHOOL GOING CHILDREN BELONGING TO 3-12 YEARS AGE GROUP

Thesis

Submitted to

All India Institute of Medical Sciences, Jodhpur

In partial fulfillment of the requirement for the degree of

Doctor of Medicine (MD)

Ophthalmology

July, 2020 **Dr. Falguni Roy**
AIIMS, Jodhpur

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DECLARATION

I hereby declare that this project titled "**A study of prevalence and risk factors of amblyopia in school going children belonging to 3-12 years age group**" is the bonafide record of my original research. It has not been submitted to any other institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

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CERTIFICATE

This is to certify that the thesis titled "**A study of prevalence and risk factors of amblyopia in school going children belonging to 3-12 years age group"** is the bonafide work of **Dr. Falguni Roy** under my guidance and supervision, in the Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur.

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CERTIFICATE

Certified that the project titled "**A study of prevalence and risk factors of amblyopia in school going children belonging to 3-12 years age group**" is the record of research done in this department by **Dr. Falguni Roy.** She has fulfilled all the necessary conditions for the submission of this research work.

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Dr. Falguni Roy

LIST OF ABBREVIATIONS

P cells	Parvocellular cells
M cells	Magnocellular cells
ODC	Ocular dominance columns
LGN	Lateral Geniculate nucleus
GABA	Gamma-aminobutyric acid
LGB	Lateral Geniculate body
UA	Unaided visual acuity
BCVA	Best Corrected Visual Acuity
logMar	Log of minimal angle of resolution
ATS	Amblyopia Treatment Study
RCT	Randomized Controlled Study
LCG	Liquid Crystal Glasses
CAM	Cambridge Visual Stimulator
PRK	Photorefractive keratectomy
LASIK	Laser-assisted in situ keratomileusis
IOP	Intraocular Pressure
EOM	Extraocular movements
CS	Contrast Sensitivity
CV	Colour Vision

SYNOPSIS

Amblyopia is a unilateral or less commonly, bilateral reduction of best-corrected visual acuity that occurs in the setting of an otherwise normal eye, or a structural abnormality involving the eye or visual pathway, with a reduction in visual acuity that cannot be attributed only to the effect of the structural abnormality.[1] The improper stimulation of the neural pathways between the brain and the eye leads to vision loss. Even when wearing glasses, the amblyopic eye forces the brain to "learn" to only perceive hazy images. Because the other eye's vision is weak, the brain favors the superior eye.[2] The prevalence of amblyopia worldwide ranges from 0.2% to 6.2%.[7]

Amblyopia is classified in terms of disorders or combinations of disorders responsible for its occurrence. It is classified into Strabismic amblyopia, Refractive amblyopia, and Visual deprivation amblyopia. Amblyopia is almost four times more common in children who were premature, small for gestational dates, or who have a first-degree relative with amblyopia. The prevalence of amblyopia in children with developmental delay is sixfold greater than in healthy, full-term infants. Environmental factors including maternal smoking and drug or alcohol use during pregnancy may be associated with an increased risk of amblyopia or strabismus.[2]

Strabismic amblyopia develops when the eye with constant, non-alternating or unequally alternating tropias, most commonly being esodeviations.[1]

Refractive amblyopia occurs as a result of untreated unilateral or bilateral refractive errors. This form may manifest with strabismus. Bilateral refractive amblyopia is less common relatively.[1]

Visual deprivation amblyopia is due to partial or complete obstruction of ocular media, resulting in blurred images in the retina. The most common are congenital cataract, early onset developmental cataracts, corneal opacity, vitreous hemorrhage, and ptosis. Deprivation amblyopia is of rare type and the most severe type and difficult to treat.[1]

Amblyopia is an important public health problem because of its profound lifelong visual impairment and its prevalence among children. Both amblyopia and its treatment can have a

substantial impact on quality of life. Early screening is important for both the prevention and treatment of amblyopia. The potential for successful treatment is greatest among young children.

Our study aims to screen preschool and school-going children and determine the risk factors of amblyopia in the different groups of children so that effective measures can be taken to prevent it.

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INTRODUCTION

INTRODUCTION

Amblyopia is a unilateral or, less commonly, bilateral reduction of best-corrected visual acuity that occurs in the setting of an otherwise normal eye, or a structural abnormality involving the eye or visual pathway, with a reduction in visual acuity thatcannot be attributed only to the effect of the structural abnormality. [1]

Early in childhood (during the cortical plasticity stage), anomalous visual inputs to each eye occur where different action potentials (in amplitude or timing, or both) generated in the retina reach the cortex. This condition is known as amblyopia, and it is a cortical developmental disorder. These cortical modifications cause the visual cortex to favour one eye over the other, resulting in a variety of functional deficiencies in the eye, altered visual function such as decreased vernier acuity,impaired contrast sensitivity, particularly to detect high spatial frequency stimuli and impaired motor signs such as hand-eye coordination and spatial localization. These deficiencies can be unilateral or bilateral. [2]

The critical age of amblyopia is 2-3years and it is relatively easy to correct it at this age by improving the quality of visual input in the affected eye. [3]

Symptoms of amblyopia include unilateral diminution of vision, decreased contrast sensitivity, decreased stereo acuity, and crowding phenomena which lead to a negative impact on the patient‟s daily life and social functioning, making amblyopia an important public health problem. [4]

Unilateral amblyopia is defined as 2 lines or more of difference in best-corrected interocular VA, without considering the presence or absence of amblyopia risk factors. Bilateral amblyopia is defined as best-corrected VA in each eye worse than 20/50 for 3-year-olds and worse than 20/40 for 4 to 5year old‟s. [5] Anisometropic amblyopia is present if there was a difference of 1D in spherical equivalent or 1.5D in astigmatism between the two eyes with no measurable strabismus [6]. Strabismicamblyopia is said to be present if amblyopia with heterotopia at distance and/or near fixation with a spherical equivalent interocular difference <1.0D and <1.5D interocular difference in astigmatism.

Combined amblyopia is the presence of amblyopia with both strabismus and anisometropia amblyopia. Amblyopia is often classified on the basis of visual acuity as mild, moderate and severe. Visual acuity of <6/9 to 6/12 is classified as mild; visual acuity worse than 6/12 to 6/36 is classified as moderate and visual acuity worsethan 6/36 is classified as severe. [8]

Risk factors for amblyopia are premature birth, small for gestational age, developmental delay, or having a first-degree relative with amblyopia. Environmental factors, including maternal substance abuse during pregnancy, have been reported to be associated with an increased risk of amblyopia or strabismus in some studies. [2]

To identify the risk factors for amblyopia, vision screening is crucial. For both the prevention and treatment of amblyopia, early screening is essential. The earlier the refractive error and strabismus are treated, the greater the likelihood of preventing amblyopia. The younger age group have a higher chance of undergoing successful treatment. The likelihood of regaining normal vision in an amblyopic eye depends on a number of variables, such as the time since the onset of the amblyogenic stimulus, the cause, extent, and duration of the condition, the course of prior treatment, adherence to treatment recommendations, and coexisting conditions. [1]

Our study focuses on screening preschool and school-going children between 3-12years and finding the prevalence and risk factors of amblyopia in the different age groups belonging from 3-12 years. Through our study, we would educate the parents and the teachers about the risk factors of amblyopia and also raise awareness about the importance of screening and treatment.

AIMS
&
OBJECTIVES

AIMS AND OBJECTIVES

RESEARCH QUESTIONS: What is the prevalence of amblyopia in preschool and school-going children belonging to 3-12 years age group?

What are the risk factors of amblyopia in preschool and school-going children belonging to 3-12 years of age group?

AIM: To study the prevalence and risk factors of amblyopia in preschool and school-going children belonging to 3-12 years age group.

OBJECTIVES:

PRIMARY OBJECTIVE:

1. To screen the preschool and school-going children between 3-12 years age group for amblyopia.
2. To study the prevalence of amblyopia in preschool and school-going children between 3-12 years of age group.
3. To evaluate the risk factors of amblyopia in preschool and school-going children belonging to 3-12 years age group.

SECONDARY OBJECTIVE:

1. Administer amblyopia therapy to children diagnosed with amblyopia and also treat the treatable causes of amblyopia such as strabismus, cataract, ptosis etc.
2. Counselling the parents whenever required.
3. To provide treatment to those who have associated medical problems which needs intervention from a pediatric or general physician or super-specialty departments

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Amblyopia is a major health problem, the effects of which last a lifetime and hence require care and commitment from parents, and ophthalmologists to achieve the best possible results. Amblyopia screening and treatment are effective in terms of clinical outcome and in reducing amblyopia prevalence. The time constant for treatment imposed by a limited period of visual development and maturation creates the need for screening programs, capable of detecting amblyopia at an early age. Since amblyopia is treatable, the earlier it is detected the better the prognosis. All children should undergo screening evaluation for amblyopia and its risk factors.

AMBLYOPIA:

Amblyopia is a unilateral or less commonly bilateral reduction of best-corrected visual acuity that occurs in the setting of an otherwise normal eye, or a structural abnormality involving the eye or visual pathway, with a reduction in visual acuity thatcannot be attributed only to the effect of the structural abnormality. [1]

Pathophysiology of amblyopia is derived from the pioneering work done by Hubel and Weisel . Parvocellular (P cells) and magnocellular (M cells) are the two types of ganglion cells that make up the retina. [12] The former is found in the foveal and parafoveal regions, while the latter is found in the peritoneal and peripheral regions. Numerous ganglion cells respond to direction, fire when an image moves in one way but not the other. [12] P cells have a bigger representation in the sensory cortical areas than M cells do. [13] There is once again a dichotomy of the ganglion cells. P cells are involved in fine visual acuity, fine stereopsis, and colour vision. M cells are engaged in gross stereopsis and movement detection. [12] Again, the ganglion cells are dichotomous. The axons of ganglion cells on the nasal side of a line dividing the fovea into nasal and temporal halves cross to the other side, while those on the temporal side proceed to the geniculate nucleus on the same side. Retinal fibers end inthe lateral geniculate nucleus in specific layers. [13]

The ocular dominance columns (ODC), in which the inputs from the two eyes alternate equally, are formed by the segregation of the relay cell axons in the lateral

geniculate nucleus over the first three weeks of life, according to research by Hrubel and Wiesel. [14] If one eye is closed at birth, its ocular dominance bands contract and those from the other eye grow. Enlargement of the LGN cell bodies is hypothesized to be caused by the more extensive axonal arborizations in the expanded ocular dominance bands of the other eye in the visual cortex. The number of synapses in the primary visual cortex continues to increase until 6 months of age, after which it gradually falls back to adult levels. [15] It's possible that the development of these connections over time is what makes them more vulnerable to vision impairment and the various symptoms of monocular impairment as they get older. [16] Compared to magnocellular cells, parvocellular cells place greater importance on these interactions.

The cerebral circuitry is still developing during the postnatal period. Ocular dominance is interchangeable, plasticity is necessary for development, and the ODC matures for another 36 months after birth. [17] The GABAergic interneurons in layer 2 and 3 of V1 finish the development process by ensuring that the visual experiences from the two eyes coincide. [18] The maturation process makes the cortical circuit immune to altered visual experience as happens after the age of 10 years. However, cortical plasticity is never fully lost in adults, and if there are any ways to restore the plasticity of the cortical circuit, amblyopia is curable. These interneurons are inhibitory in nature, and inhibition of these interneurons can theoretically prolong the plasticity period. [19]

Although it manifests as decreased visual acuity in the amblyopia eye, Oessaud et al. stated that amblyopia is a developmental disorder of the entire visual system. Other abnormalities of the visual function, such as decreased contrast sensitivity and stereoscopic vision, are observed, and some abnormalities can be found in the "good eye." Amblyopia may be caused by organic pathology of the visual pathways, visual deprivation, and/or functional problems, especially anisometropia or strabismus since it occurs at the vital phase of the brain's development. [20]

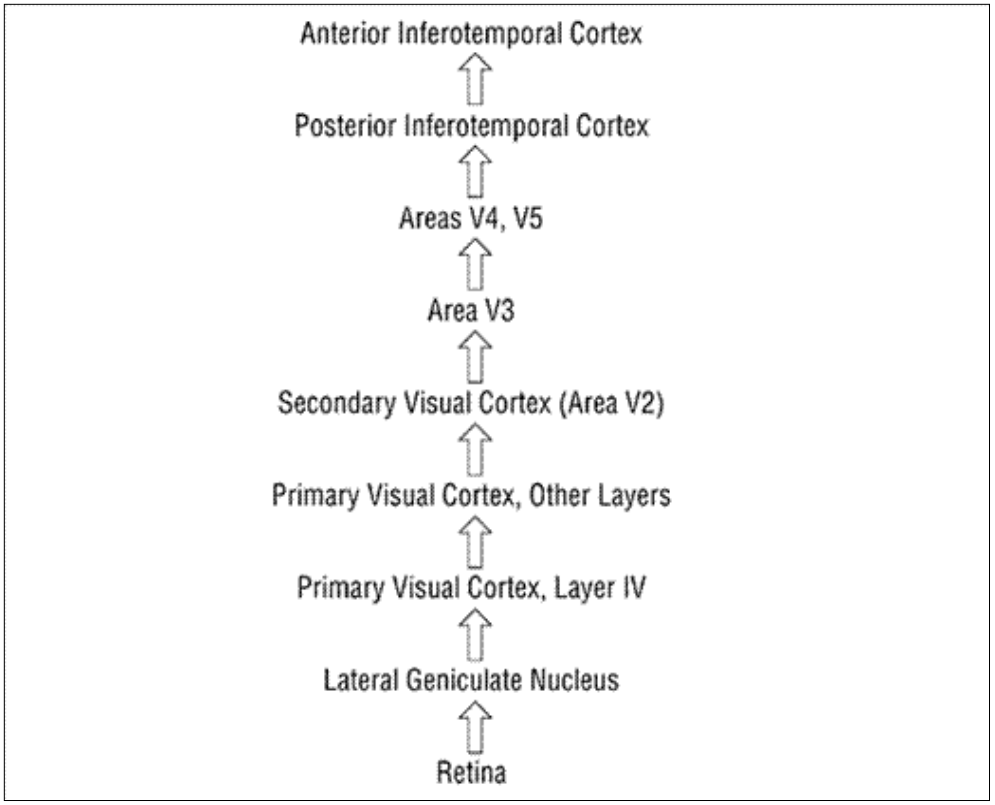

Figure 1: Sequence of visual area in the brain of macaque monkey (Adapted from Critical periods and Amblyopia; Nigel .Daw)

The order of the visual regions as they are organized in the macaque monkey's brain. The main visual cortex in the occipital brain receives signals from the retina before being projected to other intermediate sections of the cortex and finally to the temporal cortex. For the macaque monkey, areas V2, V3, V4, and V5 have been identified. Still being discovered are the analogous regions in the human cortex. The visual properties that each area processes are only partially understood: the retina converts signals about brightness into signals about contrast; the primary visual cortex integratesinformation from the two eyes; cells in the primary visual cortex analyze the orientation of edges and direction of movement; area V4 processes colour and form; area V5 processes movement and depth; and faces are processed in the macaque monkeys and human's temporal cortex in a region near the temporal lobe (color agnosia and prosopagnosia have separate locations). [21]

Visual experiences, both uniocular and binocular, have a significant impact on the growing functional and anatomical organization of the visual system during a period

of extraordinary developmental plasticity. Visually significant circumstances, such as visual deprivation, strabismus, anisometropia, or the aberrant visual environmentduring the time, result in severe electrophysiological and morphological abnormalitiesin the striate cortex and lateral geniculate nucleus. There are reductions in the number of cells that respond to deprived vision, a loss of binocularly responsive cells, sharing of cells in the LGB laminae that serve the deprived eye, and severe anomalies in the response characteristics of the cells that endure throughout life. [22]

The phrase "critical period" started to be used frequently. It refers to the time when deprivation has the most impact rather than the initial stages of development or the time when recovery is possible. [23] Amblyopia is a condition that has its roots in the concept of key phase of visual development plasticity. The critical period starts at 4 months of life, likely reaches its peak by 2 years, is significantly reduced by 5 years, and then experiences a steady decline before ceasing around 12 years of age. Not all visual functions may have the same time beginning of the critical period. [24]

Strabismic amblyopia: Constant, non-alternating, or unequally alternating tropics (usually esodeviations) are likely to produce amblyopia. This condition is known as strabismic amblyopia. The fixating eye dominates the cortical vision centers as a result of competing or inhibitory interactions between the neurons carrying the non-fusible inputs from the two eyes, and the non-fixing eye's response to input is chronically decreased.[25]

Refractive amblyopia: Untreated unilateral or bilateral refractive defects lead to amblyopia. When the two eyes' different refractive errors result in one eye's retinal image being chronically more out of focus than the other, anisometropic amblyopia develops. This type of amblyopia can happen along with strabismus. Purely ametropic amblyopia is believed to be caused by interocular competition or inhibition that is similar (but not necessarily identical) to that which causes strabismic amblyopia. Image blur is hypothesised to directly affect the growth of visual acuity in the implicated eye, leading to interocular competition or inhibition. Amblyopia is more likely to occur and becomes more severe when there are higher degrees of anisometropia or astigmatism. Early childhood bilateral astigmatism that is not treated

can cause loss of resolving power just in the chronically blurred meridian (meridional amblyopia). [25]

For ametropic amblyopia: Patients with refractory errors more than > 1.0D spherical in both eyes resulting in vision less than 6/12 or equal to 6/12 in one or both eyes and no associated strabismus or any other ocular pathology .Anisometric amblyopia: Who had amblyopia in the presence of anisometropia that was 1 D or greater than 1 D in spherical or 1.5 D or greater difference in astigmatism between both the eyes that had persisted for more than 4 weeks after spectacle correction, in the absence of any measurable heterophoria. [25]

Meridional amblyopia: Patient who had regular astigmatism equal to or more than 1.5 D of astigmatism in both eyes, resulting in decrease of vision in one or both eyes and no associated strabismus or other ocular pathology. [26,27]

Visual deprivation amblyopia: A blurry image appears on the retina as a result of total or partial occlusion of the ocular medium. Congenital or early-onset cataracts are the most prevalent cause of deprivation amblyopia, but other factors such as corneal opacities, infectious or non-infectious intraocular inflammation, vitreous hemorrhage, and ptosis are also implicated. Although it is the least frequent type of amblyopia, it is also the most severe and challenging to treat. Due to the direct developmental effects of extreme image degradation, the amblyopic visual loss brought on by a unilateral obstruction within the pupil is likely to be greater than that brought on by a bilateral deprivation of a similar degree. The visual acuity in bilateral cases can be 20/200 or worse. Newborns with visually threatening unilateral cataracts have a favorable prognosis when the cataract is removed and optic correction is in place by 1 to 2 months of age. Amblyopia is more common in children who were premature, smallfor gestational age, developmental delays. Environmental risk factors include maternal smoking, and drug or alcohol use during pregnancy. Amblyopia is classified as deprivation, strabismic and refractive.[25]

Clinical features:

It's crucial to keep in mind that the following requirements must all be met before an amblyopia diagnosis could be made.

1. Signs of decreased visual acuity are typically unilateral but can also be bilateral.

2. The presence of amblyogenic factors in a child in the amblyogenic age group, such as strabismus, severe uneven or uncorrected refractive error, and signs of visual deprivation due to congenital cataract, ptosis, or corneal opacity.
3. The loss of vision has no other explanation.

Reduced foveal acuity is the hallmark feature of amblyopia. Unilateral amblyopia is defined as at least a two-line difference on the Snellen chart or a two-octave difference on the preference gazing test. The visual acuity in each eye must be less than 20/40 for bilateral amblyopia. A visual acuity of 20/40 or worse with at least a 3 log MAR line difference between the eyes was considered amblyopia according to the amblyopia treatment study.[28]
Children greater than 3 years visual acuity can be determined by Snellen‟s chart‟s, "E" charts or pictorial charts can be used.

Amblyopic factors:
Premature birth, small for gestational age, developmental delay, or having an amblyopic first-degree relative are risk factors for amblyopia. According to some studies, environmental factors, such as maternal substance abuse during pregnancy, are linked to an increased risk of amblyopia or strabismus. Amblyopia is nearly four times more common in children who were born prematurely, were small for gestational dates, [29,30] or had an amblyopic first-degree relative. [31,32] Compared to healthy, full-term infants, children with developmental delays are six times more likely to have amblyopia. [33] An increased risk of amblyopia or strabismus may be attributed to environmental variables including maternal smoking [34] and drug or alcohol use during pregnancy. [35]

The high amblyogenic tendency is present in unilateral congenital cataracts, ptosis, or other medial opacities. High levels of refractive error, particularly hypermetropia of more than 3.5D and astigmatism of >1.5D, should raise suspicions of amblyopia. Microtropia and small angle esodeviations are also frequently found in association with amblyopia. Similar to strabismus, visual deprivation, and refractive error, bilateral amblyopia can be caused by these conditions. [36]

How to screen amblyopia?

Measuring visual acuity is crucial since best corrected visual acuity is a key component of the amblyopia diagnosis. It's also important to look for amblyogenic variables including cataracts, ptosis, and strabismus by performing a comprehensive anterior segment examination. It's crucial to perform a dilated fundus examination to rule out any posterior section abnormalities.

When to screen amblyopia?

When to screen for amblyopia is a topic of debate. The benefit of screening children in this age group is that effective intervention can be taken to treat amblyopia and its cause. Effective measure in the long term not only decreases the prevalence of amblyopia but also decreases long term ocular morbidity. Since the critical period is between 3 and 12 years, it is better to screen children in this age group. enhances one's quality of life. [24]

Prevention:

The earlier clinically significant refractive error and strabismus are found and treated, the greater possibility for presenting amblyopia.[37] Vision screening is necessary to identify characteristics that predispose to amblyopia.[38] Even while older kids and teenagers might reasonably be expected to experience an improvement in visualacuity when amblyopia is present, it appears that the likelihood of successful therapyis highest in young children.[39]

A study by Pediatric Eye Disease Investigator group of treatment for moderate strabismic and /or anisometropic amblyopia demonstrated that the visual acuity of the amblyopic eye improved to 20/30 or better 6 months after initiating treatment in approximately three-quarters of children under 7 years of age.[40]

Treatment of amblyopia:

The likelihood of achieving normal vision in an amblyopic eye depends on a varietyof factors, including the age of onset, the cause, the severity, the duration of amblyopia, adherence to the treatment, and coexisting factors. The foundation of treatment is the correction of the cause, which is a refractive error, the removal of the cause of deprivation, the correction of strabismus, and the promotion of the amblyopiceye over the normal.

Treatment is based on the child‟s age, visual acuity, and compliance and response to previous treatment as well as the child‟s physical, social, and psychological status. Treatment of amblyopia includes:

1. Optical correction of significant refractive error

2. Patching

3. Pharmacological treatment

4. Refractive surgery

5. Alternative therapies.

Refractive error correction: Regardless of whether the cause is anisometropic, strabismic, or both, treating refractive error alone is the first step. [41] The amblyopic eye's visual acuity improves significantly between 4 and 12 weeks after which it reaches a plateau and continues to steadily improve. [42] It takes 18 to 22 weeks to acquire the best results from refractive adaptation.

Occlusion: The amblyopia treatment study (ATS) found that six hours of prescribed daily patching produces an improvement of visual acuity that is similar in magnitude to full-time occlusion therapy prescribed for treating severe amblyopia in children under the age of seven. If VA in the amblyopic eye fails to improve further by using spectacles, and there is still a difference of 0.20 logMAR or more between the two eyes, occlusion therapy is initiated. When used as initial therapy for children with mild amblyopia, 2 hours of prescribed daily patching improves visual acuity in a manner comparable to that of 6 hours of daily patching. Through the age of 15, the treatment's positive effects seem to stay stable. For older kids and teenagers, patching should be taken into consideration, especially if they have never received treatment.[43]

Pharmacological treatment:

i) Atropine penalization- It is now a recognized method of treating amblyopia and is frequently utilized in place of occlusion therapy, particularly when there are problems with adherence, occlusion failure, or maintenance therapy. By paralyzing the ciliary

muscle, atropine solution 1% optically defocuses the non-amblyopic eye. In a preliminary investigation by Foley Nolan et al., atropine penalization as the main treatment for strabismic and/or anisometropia amblyopia was found to be beneficial. [44] The first ATS study compared the effectiveness of daily administration of 1% atropine in the sound eye to 6 hourly daily patching in children of 3 to 7 years with moderate amblyopia and found similar improvement. Though the improvement was slower with atropine penalization, the magnitude of improvement was similar in 6 months. A subsequent RCT compared less frequent administration of 1% atropine drops (weekend only) to daily atropine in children 3 to 7 years old with amblyopiaand found similar improvement in 4 months durations. Atropine penalization may be systemic side effects, including dry mouth, tachycardia, delirium, photophobia, ocular pain, headache and lowed seizure threshold. [43]

ii) Levodopa-Carbidopa: Iuvone et al. have put forth the theory that elevating dopamine levels, which are decreased in deprivation amblyopia, may improve vision.[45] In a different prospective trial, when daily levodopa with carbidopa was prescribed along with continued 2 hour/day patching in cases of moderate amblyopia, no clinically significant or meaningful improvement in VA was observed.[46]

iii) Citicoline: confers both cholinergic and neuroprotective qualities. Early research in adults showed improvement in VA with citicoline augmenting patching, but this improvement was not maintained following medication discontinuation. Levodopa's use is the subject of more research than citicoline, and as of the time of this analysis, none of the studies on citicoline had included follow-up periods longer than 3-6 months.[47]

Optical penalization: The term "optical penalization" refers to the blurring of the normal eye, which is usually accomplished by positive defocus (overplus glass) or by using a plano lens in place of the normal eye's optical correction. This procedure is frequently used in children who have received atropine treatment but have not yet achieved normal VA in the amblyopic eye, and it has been hypothesized that atropine and optical penalization may work together in synergy.[48] In cases of moderate amblyopia, optical penalization may be helpful as a first line of treatment, a maintenance regimen, or an alternative treatment if patching fails. There are cases of

reverse amblyopia when atropine treatment is combined with under-correcting hypermetropia in the non-amblyopic eye with a plane lens, therefore VA of the non-amblyopic eye should be carefully monitored.[49]

Bangenter filter: Bangerter filters are semi-opaque foils that can be affixed to spectacles in order to diminish the VA of the non-amblyopic eye. They are an alternative therapy option for mild to moderate anisometropic amblyopia. These blur filters are available in many grade densities and are intended to lower VA to a range of 0.0 to 1.0 log MAR. [50] They are mounted to the back of the spectacle lens of the amblyopic eye and are worn all the time. These carefully chosen filters must result ina decrease in VA to a range where there is no amblyopia of the eye. The Bangerter filters were found to have a quicker rate of VA recovery in a randomized trial by Ageri et al, although there was no difference after a year.[51]

Emerging trends in amblyopia treatment :

i) Liquid Crystal glasses: It offered the non-amblyopic eye an electronic, controlled occlusion. [52] In light of this, an LCG lens is utilised as an intermittent flickering shutter switched between "on" or occlusion or "off" or light transmission in front of the non-amblyopic eye. The flickering interval can be changed depending on the patient's age, the severity of their amblyopia, and the length of their treatment. A possible alternative therapy for children with moderate amblyopia aged 3 to 8 years old is intermittent occlusion therapy with LCG, according to some studies. [53]

ii) Perpetual learning: Refers to "any relatively permanent and consistent change in the perception of a stimulus array, following practice or experience with this array."[54] The Cambridge Visual Stimulator (CAM), a device that allowed patients to passively view high contrast rotating five-wave gratings with the amblyopic eye, is thought tobe the first implementation of perpetual learning theory. [55] In several investigations on adult amblyopia, it was discovered that training in monocular perception not only improved the monocular function of the participants' amblyopic eye but also their ability to combine their monocular and binocular vision. [56] To rebalance the interocular balance of excitatory and inhibitory contacts, "push-pull" treatment simultaneously stimulates the weak eye while entirely blocking the perception of the strong eye. [57]

iii) Video gaming: The use of video games is based on the idea that they improve a variety of visual skills in people with normal vision, such as light sensitivity, [58] contrast sensitivity, [59] visual crowding, [60] and visual attention.[61] Three methods have been developed to study their impact on amblyopia. The first is to play a video game while wearing a patch over the non-amblyopic eye to enhance aspects of crowding. The second technique uses dichoptic vision as an anti-suppression tactic, presenting an identical background to both eyes while giving the amblyopic eye a more enriched foreground. Playing a video game made particularly to induce stereopsis is the third tactic.[62]

iv) Dichoptic training: To overcome suppression and enable binocular combination, stimuli are delivered individually to each eye, with lower contrast stimuli being presented to the fixed eye.[63] In the event that subjects complete the task successfully, the contrast in the dominant eye is gradually increased until it is equal in both eyes. According to the theory behind this design, the adult brain cannot learn to see through an amblyopic eye because inhibitory signals from the fixed eye dampen corticalinputs from the amblyopic eye.[64]

Refractive surgery: Children who are unable to use normal eyeglasses or contact lenses due to severe anisometropia and isometropia linked with amblyopia haveundergone effective refractive surgery. Photorefractive keratectomy (PRK), laser- assisted subepithelial keratomileusis, and laser-assisted in situ keratomileusis are examples of extraocular procedures (LASIK). [65] Due to the strict indications for pediatric refractive surgery and the concerns for long-term effects on the developing eye, the field of pediatric refractive surgery has developed slowly, and publications are scarce. Intraocular techniques include refractive lensectomy and phakic intraocular lenses.[66]

Valeria Mocanu et al [7] conducted a study in 2017 to study the prevalence and the risk factors of amblyopia in a pediatric population with refractive errors from an Eastern European Country. The study consisted of 1231 children aged between 5- 16years who had a refractive error. A cross-sectional study was done from January to August 2017. Every child underwent an ophthalmological evaluation. Amblyopia was defined as Visual acuity less than 0.63. Parents‟ participation was required for

interviewing. The questionnaire contained details about their family history of amblyopia, the child‟s maternal nutritional status preconceptiontion period, the history of maternal smoking or work in a toxic environment, the child‟s birth history, history of congenital nasolacrimal duct obstruction (CNLDO). Amblyopia was prevalent in 2.8% of the participants. Amblyopia was also linked to ocular abnormalities such as hyperopia (p=0.0079), astigmatism (p=0.046), anisometropia (p0.0001), esotropia (p0.001), exotropia (p=0.0195), CNLDO (p0.001), and a family history of amblyopia (p0.001). Low birth weight (p 0.0009), prematurity (p 0.001), an Apgar score under 7 (p = 0.0008), mother age, maternal smoking history, or work in atoxic environment (p 0.001) were non-ocular risk factors for amblyopia. The study found that the risk variables were controllable, thus prenatal women must receive proper health education to ensure better management.

Sunil Ganekal et al [8] conducted a study in 2013 to study the etiology and prevalence of amblyopia in school children in Southern India. A total of 4020 kids between the ages of 5 and 15 were recruited for the study. All students underwent comprehensive ophthalmological testing and had their vision corrected to the best corrected visual acuity. Ametropic amblyopia is the name given to amblyopia caused by a high refractive error that results in poor visual input. Anisometric amblyopia was identified when the interocular refractive error was >=1D different. Squinting-related visual input conflicts between the eyes were identified as strabismic amblyopia. Deprivation amblyopia is the term used to describe amblyopia caused by obstruction in the visual field. Amblyopia was 1.1% prevalent (n = 44). Boys were somewhat more likely to experience amblyopia (n=25,57%) than females (n=19,43%, p=0.6). 16 children (36.3%) had severe amblyopia, whereas 28 (63.7%) had mild to moderate amblyopia. Ametropia (50%) and anisometropia (40.9%) were the underlying amblyogenic causes, followed by strabismus (6.8%), visual deprivation (4.5%), and mixed causes (2.2%). There was no statistically significant difference between children in rural areas (1.2%) and urban areas (0.9%) in terms of the prevalence of amblyopia. They came to the conclusion that ametropia and anisometropia were the most frequent causes of amblyopia and that their incidence among schoolchildren was1.1%.

Bhatnagar KR et al [9] conducted a study in 2019 to determine the prevalence of amblyopia among 6 to 16 years old school-going children in Faridabad, Haryana. 2,370 randomly chosen students were included in the cross-sectional study. Snellen's chart was used to measure visual acuity. Retinoscopy and an autorefractometer were used to measure the refractive errors. A cover test was utilized to examine strabismus. The fundus, red reflex, anterior segment, and lens opacities were all evaluated by direct ophthalmoscopy. Best corrected visual acuity of less than 6/12 or 20/40 in one or both eyes without any structural issues was used to identify functional amblyopia. With differences between the genders, 1.39% of participants (n=33) had amblyopia. More males (n=22; 66.66%) than females (n=11; 33.33%) were amblyopic. 28 (84.84%) students had amblyopia due to refractive defects, which included hyperopia (17), myopia (7), and astigmatism (4). One (3.03%) student had amblyopia brought onby a poor vision. We discovered strabismus in 4 (12.12%) of the cases. Anisometropia (24) (72.72%) and hyperopia (17) (51.51%) were significant amblyogenic risk factors for refractive errors. There were more cases of unilateral amblyopia (29/33) than bilateral amblyopia (4/33) (P 0.001). More people (25/33) with moderate amblyopia than (8/33) with severe amblyopia (P=0.004). The study found that the most effective method for identifying refractive and amblyopic problems is school screening. It is very helpful in detecting treatable causes of visual impairment early on, particularly refractive problems, and in avoiding long-term repercussions. Amblyopia was mostly caused by refractive error, which, if not treated promptly, can result in long-term visual impairment as well as financial and psychological issues in later life. The study placed a strong emphasis on the necessity of screening programs in schools, public awareness campaigns (for proper spectacle prescription), and parent education.

Karen Hendler et al [10] conducted a study in 2012 to report the outcome of ophthalmic examination in preschool children in LA country, who failed duringscreening with Retinomax autorefractor. Under the University of California Los Angeles (UCLA) preschool vision programme, approximately 11,260 preschoolers in the Los Angeles region between the ages of 3-5 were screened using the Retinomax Autorefractor. The ophthalmologists aboard the UCLA Mobile Eye Clinic examined the 1007 kids who failed the screening. Amblyopia was classified as bilateral if the best-corrected visual acuity (BCVA) was 20/50 for children under 4 years old and 20/40 for children over 4 years old, and as unilateral if there was a >2-line interocular

difference. 740 (74% of the people screened) had their glasses prescription. For all of the children that were tested, the uncorrected visual acuity was 0.4± 0.2 (logMAR mean SD), and the BCVA was 0.2± 0.1. 58% of the 88% of patients who underwent cycloplegia had hyperopia (SE >= +0.50 diopter [D]), with a mean of +2.50 D, while 21% had myopia (SE =-0.50 D), with a mean of -1.40 D. 69% of people had astigmatism, with a mean of 1.97 D. (range 0–5.75). In 26% of those analysed, spherical and cylindrical anisometropia both exceeded 1.00 D. 0.8% of the original population, or 9% of those evaluated, had refractive amblyopia. Early detection and treatment of uncorrected refractive problems and amblyopia are made possible by screening. Early intervention improves quality of life and prevents amblyopia in children.

Sapkota K et al [11] conducted a study in 2011 to determine the prevalence and the pattern and types of refractive error in children with amblyopia in a tertiary care center in Nepal. All children at the Nepal eye hospital had cycloplegic refraction and an ophthalmological examination. Refractive error patterns were identified, as well as relationships between different forms of refractive error and amblyopia. 0.7% (440) of the 62,633 kids that were examined in NEH throughout the study period had amblyopia. The average age of the patients was 7.74± 2.97 years, and 248 (56% of them) were men. The most frequent factor contributing to amblyopia was anisometropia (p 0.001). Due to severe ametropia, one-third (29%) of the individuals developed bilateral amblyopia. With a visual acuity of 20/120 or worse, severe amblyopia affected 40% of the eyes. Astigmatism affected 59.2% or about two-thirds of the eyes. According to the study, anisometropia is the most common cause of amblyopia, which has a frequency of 0.7% in the Nepal Eye Hospital.

Pascual M et al [67] conducted a study to evaluate risk factors for unilateral and bilateral amblyopia in the Vision in Preschoolers (VIP) belonging to 3-5years age group Head‟s Start pre-schoolers . All children underwent thorough eye exams, including cover testing, cycloplegic retinoscopy, threshold visual acuity (VA), and ophthalmologists and optometrists with VIP certification and paediatric patient care experience. Monocular threshold VA was assessed using a single-surround HOTV letter protocol without correction, and when retest requirements were satisfied, the assessment was repeated with full cycloplegic correction. An interocular difference in

best-corrected VA of two lines or more was used to characterise unilateral amblyopia. For 3-year-olds and 4- to 5-year-olds, bilateral amblyopia was defined as a best-corrected VA in each eye that was worse than 20/50 and worse than 20/40, respectively. . In which this larger sample of Head Start students (n = 3869), 144 students (3.7%) and 296 students (7.7%) showed bilateral and unilateral amblyopia respectively. An elevated likelihood of unilateral amblyopia was independently linkedto the presence of strabismus (P0.0001) and larger magnitudes of major refractive errors (myopia, hyperopia, astigmatism, and anisometropia; P 0.00001 for each). 91% of children with unilateral amblyopia had strabismus, hyperopia of 2.0 diopters (D) or more, astigmatism of 1.0 D or more, or anisometropia of 0.5 D or more. Higher levels of bilateral hyperopia (P 0.0001) and astigmatism (P 0.0001) were independently linked to a higher probability of bilateral amblyopia. 76% of kids had bilateral astigmatism or hyperopia of at least 3.0 D on each side.

Gupta M et al [68] conducted a study to know the profile and pattern of amblyopia in children aged 5-15 years with refractive error in Uttarakhand and to compare it with national and regional (South Asian) studies. 360 children aged 5 to 15 who visited the OPD between September 2014 and February 2015 underwent thorough ophthalmic examinations as part of a retrospective cross-sectional study. The study comprised children with eyesight 6/12 and no pathological lesions. Amblyopia affected 8.6% of the population (n=31), with no discernible gender differences (p>0.05). The overall prevalence of astigmatism-related amblyopia was 41.93% (n = 13), followed by hypermetropia (32.25%) (n = 10) and myopia (25.8%) (n = 8). Age of presentation was 5 to 10 years in 51.61% of cases, whereas > 10 years in the remaining instances. More people (58.06%) had binocular amblyopia than had unilateral amblyopia (41.93%).

Afsari S et al [69] conducted a study to determine the prevalence of anisometropia in Australian preschoolers by age and ethnicity, as well as to evaluate in this population-based study the risks of amblyopia and anisometropia in relation to rising ametropia levels. The Sydney Pediatric Eye Disease Study comprised 2090 kids (aged 6-72 months) who underwent thorough eye exams that included cycloplegic refraction. For the entire sample and in children of European-Caucasian ethnicity, the prevalence of SE and cylindrical anisometropia 1.0 D was 2.7% and 3.0%, respectively. For

children of East Asian ethnicity, the prevalence was 1.7% and 5.2%; South Asian ethnicity, 2.5% and 3.6%; and Middle Eastern ethnicities, 2.2% and 3.3%. The prevalence of anisometropia was lower or comparable to that found in the Strabismus, Amblyopia, and Refractive Error in Singapore research, Multi-Ethnic Pediatric Eye Disease Study, and the Baltimore Pediatric Eye Disease Study. Cylindrical anisometropia risk (OR) was 12.4 (CI 4.0 to 38.4) and anisometropic amblyopia risk (OR) was 6.5 (CI 2.3 to 18.7), respectively. An rising risk of anisometropia was discovered.

Dirani M et el [70] conducted a study to determine the prevalence of refractive error types in Singaporean children aged 6 to 72 months. A total of 3009 kids were investigated (72.3 percent participation rate). 1375 boys and 1264 girls' right eye (OD) cycloplegia data were available (mean age, 41 months). The average OD SE was 0.69 D. (SD 1.15). With no gender differences, the overall frequency of myopia was 11.0% (P = 0.91). High myopia (at least 6.00 D) was present in 0.2% of the population. Anisometropia, astigmatism, and hyperopia had prevalence‟s of 1.4%, 8.6%, and 0.6%, respectively. 95% of astigmatism (cylinder axes between 1° and 15° or 165° and 180°) was with-the-rule astigmatism. Children between the ages of 6 and 11, 12 to 23, 24 to 35, 36 to 47, 48 to 59, and 60 to 72 months, in that order, had myopia in 15.8%, 14.9%, 20.2%, 8.6%, 7.6%, and 6.4% of cases, respectively.

Pai AS et al[71] conducted a study to determine the prevalence of and factors associated with amblyopia in a sample of Australian preschool children. 27 (1.9%) of the 1422 kids they studied between the ages of 30 and 72 months had amblyopia or were suspected of having it. With a mean VA of 20/50, the amblyopic eyes' mean spherical equivalent was about 3.57 diopters. Only 3 of the 27 children with amblyopia had amblyopia previously diagnosed or treated. Amblyopia was found tobe significantly correlated with hyperopia (odds ratio [OR], 15.3; 95% confidence interval [CI], 6.5-36.4), astigmatism (OR, 5.7; 95% CI, 2.5-12.7), anisometropia (OR, 27.8; 95% CI, 11.2-69.3), and strabismus (OR, 13.1; 95% CI, 4.3-40.4) in regression analysis controlling for age, gender, and ethnic Amblyopia did not significantly correlate with maternal smoking, low birthweight (2500 g), preterm birth (37 weeks), mother age, gender, ethnicity, or socioeconomic status indicators (all P0.05).

Friedman DS et al[72] conducted a study to determine the age-specific prevalence of strabismus in white and African American children aged 6 through 71 months and of amblyopia in white and African American children aged 30 through 71 months.3.3% of white children and 2.1% of African American children had manifest strabismus (relative prevalence [RP], 1.61; 95% confidence interval [CI], 0.97-2.66). Nearly half of all strabismus in both groups was accounted for by either exotropia or esotropia. Among 84 white infants between the ages of 6 and 11 months, there was only one instance of strabismus. In children 60 to 71 months old, rates were higher (5.8% for white children and 2.9% for African Americans [RP, 2.05; 95% CI, 0.79-5.27]). 12 (1.8%) white and 7 (0.8%) African American children had amblyopia (RP, 2.23; 95% CI, 0.88-5.62). Amblyopia on both sides affected just 1 child.

MATERIALS & METHODS

MATERIALS AND METHODS

The study was conducted in the Department of Ophthalmology, AIIMS, Jodhpur in association with Department of Pediatrics AIIMS, Jodhpur, and the Department of Community Medicine and Family Medicine AIIMS, Jodhpur after obtaining approval by the Institutional Ethics Committee(AIIMS/IEC/2021/3361) and we adhered to the Declaration of Helsinki.

STUDY DESIGN: A cross-sectional, observational study.

INCLUSION CRITERIA	EXCLUSION CRITERIA
Study Group: 1. Eligible children belonging to 3 to 12 years of age who were preschool and school-going and were diagnosed as amblyopic after thorough ophthalmological evaluation. 2. The eligible children who have an amblyopic eye with best-corrected visual acuity (BCVA) of 0.2 to 0.8 logMAR (20/40 to 20/125) and 0.1 logMAR (20/25) or better BCVA in fellow eye. 3. Visual acuity difference between two eyes at least 0.2 LogMAR (2lines). 4. Children spherical equivalent difference ≥0.50 dioptres (D) between the eyes, or a difference of astigmatism in any meridian ≥1.50 D.	1. Children with other organic ophthalmic conditions that can hamper visual acuity (e.g., Glaucoma, optic nerve diseases). 2. Children who are non-cooperative for visual acuity and refraction tests.

SAMPLING

SAMPLE SIZE:

$n= Z^2 p q / l^2$

$Z^2 = 3.84$

P = 1.1% (According to prevalence reported in study conducted by Sunil Ganekal et al)

q = 98.9%

L = 5%

n= 1671

METHODS:

The study was conducted in the Department of Ophthalmology, All India Institute of Medical Sciences, Jodhpur. The study was based on preschool and school-going children residing in the Jodhpur district. After seeking permission from district health administration covering schools of government and private set up; a randomized selection of schools was done based on the representative population whose school heads have granted permission for screening. Requisition letters were sent to all the selected schools seeking permission from the respective school heads. A screening program was held in schools where children attending school were evaluated for thorough ophthalmological examination. A team of ophthalmologists and optometrists were taken for screening. After the screening, a list of students who needed further evaluation or treatment was given to their respective teachers. The parents of these students were requested to bring their children to our hospital outpatient department for further evaluation.

Parents or guardian of the children satisfying the inclusion criteria were explained about the study via a patient information sheet and written informed consent was taken either from the class teacher or guardian. Children who were willing to take partin the study were then evaluated and baseline parameters were recorded.

The children participating in the study were divided into 3 age groups. Group A included children between 3-5 years, group B between 6-9 years, and group C between 10-12years age group.

A proforma was distributed to the children by the class teacher which needed to be filled by the parents or with the assistance of the class teacher. Proforma consisted of detailed information regarding birth history which included the mother‟s age, weight, and height at the time of conception; history of any substance abuse or working in a toxic environment during pregnancy. History regarding intra-natal and post-natal complications were also taken. History regarding any ocular pathology such as congenital nasolacrimal duct obstruction, genetic diseases, family history of amblyopia, and developmental delay was taken. The filled proforma was then collected by the class teacher.

A standard procedure was followed for each participant. Each child underwent a detailed ophthalmological examination which included visual acuity, best corrected visual acuity, binocular alignment, ocular motility, intraocular pressure measurement, external examination, anterior segment examination, cycloplegic retinoscopy/refraction and funduscopic examination. These examinations wereconducted within the school premises.

Visual acuity testing comprised identifying optotypes, letters, numbers, or symbols which were preferred for assessment of visual acuity as per their age group For group A Tumbling E chart and pictorial vision charts were used while in group B and group C LogMAR acuity chart at 4m distance and Snellen‟s visual acuity chart at 6m distance were used for visual acuity assessment.

The children who could not attain 6/6 vision underwent subjective refraction. Each child underwent cycloplegic refraction and objective refraction with retinoscopy after instilling cyclopentolate eye drops. Children were prescribed glasses, post mydriatic test.

On the basis of the refractive error, refraction was classified into three groups- myopia, hypermetropia, and astigmatism. Myopia was subclassified based on severity as mild (<3.0D), moderate (3.0-6.0D), and high myopia (>6.0D). Similarly, hypermetropia was classified as mild (<2.0D) , moderate (2-4 D,)and high hypermetropia (>4.0D) . Likewise, astigmatism was also classified as mild (<1.0D), moderate (1.0-2.0D), and high astigmatism (>3.0D).

Figure 2 :Subjective refraction for assessing best corrected visual acuity

(Source: Department of Ophthalmology, AIIMS Jodhpur)

The children who could not attain the best corrected visual acuity as 6/6 were enlisted and names were given to the class teacher to bring their child to AIIMS outpatient department for further evaluation.

Intra ocular pressure was measured digitally in school premises. Whereas the children who were called in the AIIMS outpatient department, intraocular pressurewas measured with air puff method of non-contact tonometry.

External examination of lids and adnexa was done which included assessment of the eyelids, eyelashes, lacrimal apparatus, orbit. Anterior segment examination- cornea, conjunctiva, anterior chamber, iris, and lens was done using torch light and direct ophthalmoscope. Whereas the children who needed further evaluation or treatment were evaluated using slit lamp biomicroscopy in AIIMS, Jodhpur.

Figure 3: The Measurement of Corneal light reflex
(Source: Department of Ophthalmology, AIIMS Jodhpur)

After external examination, the children who were not orthotropic were further evaluated for strabismus. Hirschberg test and the cover uncover test were done. The ocular deviation was evaluated by prism bar cover test for near (0.33m) and distant (6m) fixations. Thereafter stereo-acuity was tested for strabismic children of age groups B and C using the Titmus fly stereo test & all values were transformed to logarcsec for the purpose of analysis. Extraocular movements were examined and the overaction of muscles along with the pattern of strabismus was noted.

For children with drooping of upper lids, were evaluated for ptosis and a complete ptosis workup was done which included measurement of marginal reflex distance 1 and 2, levator palpebral superioris action, examination of lid crease, Cogan twitch sign, Marcus gunn jaw winking sign as well as extraocular movement and Bell‟s phenomenon.

Funduscopic Examination included the evaluation of the optic disc, macula, retina, and vessels using an indirect ophthalmoscope and condensing lens after adequate dilation with cyclopentolate eyedrops. Fundus evaluation is important to rule out any retinal causes that can lead to decreased vision . After a thorough ophthalmological examination, the ocular causes of amblyopia were determined .

Figure 4: Indirect ophthalmoscopy

(Source: Department of Ophthalmology, AIIMS Jodhpur)

The findings were then recorded and the data was entered and analyzed using the latest version of SPSS (Statistical Package for the Social Sciences).

STATISTICAL ANALYSIS

- Data was entered and analyzed using the SPSS (Statistical Package for the Social Sciences) version 25. SPSS Statistics is a statistical analysis software package that allows you to perform interactively or batch statistical analysis. On August 8, 2017, SPSS Statistics released version 25. It was long created bySPSS Inc. before being acquired by IBM in 2009. IBM SPSS Statistics is the brand name for current versions (after 2015).
- The nominal, ordinal and continuous variables were identified.
- The data was cleaned and coded for analysis.
- All nominal variables were described using counts and percentages and analyzed using Chi-Square test or Fischer's Exact test.
- All ordinal variables were described using median and IQR and analyzed using the Mann-Whitney U test.
- All continuous variables were described using mean and SD and analyzed using the Independent Samt-test.
- The analyzed data was organized in tables.
- Graphs were plotted wherever necessary.
- A p-value of less than 0.05 was considered statistically significant.

ETHICAL CONSIDERATION

- The following study was conducted after approval from the Institutional Ethics Committee.
- Informed consent was taken from the parents or guardians of the children being enrolled in the study by providing them a proper printed consent form along with a patient information sheet and after properly explaining thepurpose.

RESULTS

RESULTS

In our study, a total of 1683 children were evaluated. The mean age of the screening population was 8.92±2.20 years, ranging from 3-12years. Amongst them, 36.19% (n=609) of children were female and 63.81% (n=1074) were male. Refractive error was detected in 99(5.88%) children. The mean best corrected visual acuity in the righteye was 0.01±-0.07 and in the left eye was 0.01±0.08. The frequency of refractive error in the age group A was 15.15%(n=15), in group B was 32.32%(n=32), and in group C was 52.53% (n=52).

In our study, the prevalence of amblyopia was 1.66% (n=28). There was no sex predilection for amblyopia in our study(p=0.255). Unilateral amblyopia(57.14%) was more common than bilateral amblyopia(42.86%). Refractive amblyopia was the most significant ocular risk factor constituting 71.43%(n=20). Anisometropic amblyopia was a significant risk factor in 67.86%(n=19) for amblyopia followed by amblyopia caused by hypermetropia which was seen in 25%(n=7) and then myopia 7.14%(n=2). The majority of the children were affected with a moderate grade of amblyopia.

The demographic details of the mother at conception were studied. The mean age for mothers‟ conception was 22.30±4.30 years. On evaluating the non-ocular risk factors for amblyopia, a significant association of amblyopia was noted with the pre-obese range BMI of 25-29.9 ($p = 0.027$) mother, children who had a history of moderately preterm birth($p<0.001$), and the children who had a history of very low birth weight ($p=0.001$) and low birth weight($p<0.001$). Ocular pathology at birth was seen in 3.57%(n=1) of children, which also had a significant association with amblyopia ($p=0.016$). We found a significant association between post-natal complications and amblyopia.

Table 1: Gender prevalence of screened children

Gender	Amblyopia				Total		p value
	Present		Absent				
	N	%	N	%	N	%	
Male	15	53.57	1059	63.99	1074	63.81	0.255
Female	13	46.43	596	36.01	609	36.19	
Total	28	100.00	1655	100.00	1683	100.00	-

A total of 1863 children were screened of which 63.81%(n=1074) were male and 36.19% (n=609) were female. Among the 28 amblyopes, 15 were males and 13 were females. There was no sex predilection for amblyopia (p=0.255).

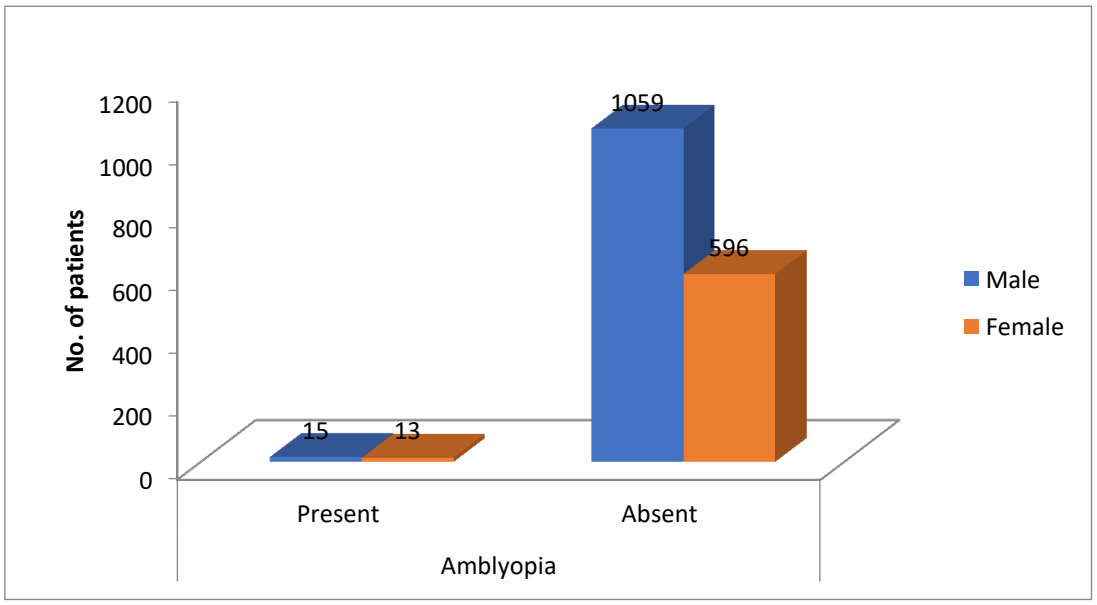

Figure 5: Gender prevalence of screened children

Table 2: Refractive error in the screened children

Refractive error	No. of patients	Percentage
Present	99	5.88
Absent	1584	94.12
Total	1683	100.00

Among the 1863 children screened 5.88%(n=99) were diagnosed with refractive error.

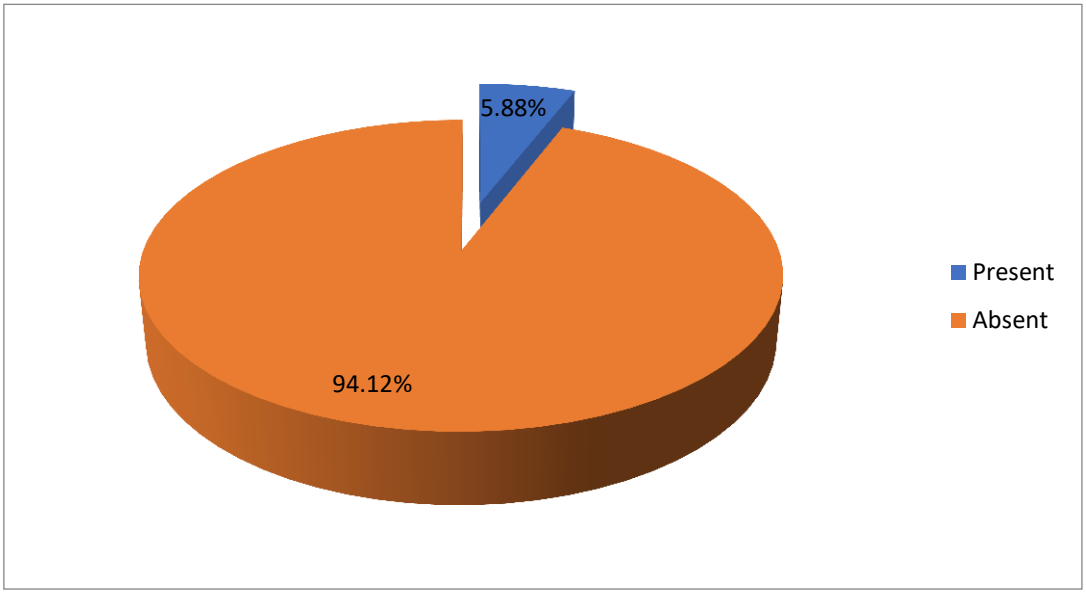

Figure 6: Refractive error in the screened children

Table 3:Age distribution of refractive error

Age (yrs)	Refractive error				Total		P value
	Present		Absent				
	N	%	N	%	N	%	
Group A	15	15.15	292	18.43	307	18.24	0.411
Group B	32	32.32	515	32.51	547	32.50	0.968
Group C	52	52.53	777	49.05	829	49.26	0.502
Total	99	100.00	1584	100.00	1683	100.00	-

The children screened were categorized into 3 groups as per their age. In group A there were 307 children, group B 547, and in group C 829 children. The frequency of refractive error in the age group A was 15.15%(n=15)(p=0.411), in group B was 32.32%(n=32)(p=0.968), and in group C was 52.53% (n=52)(p=0.502). There was no significant association of refractive error with increasing age.

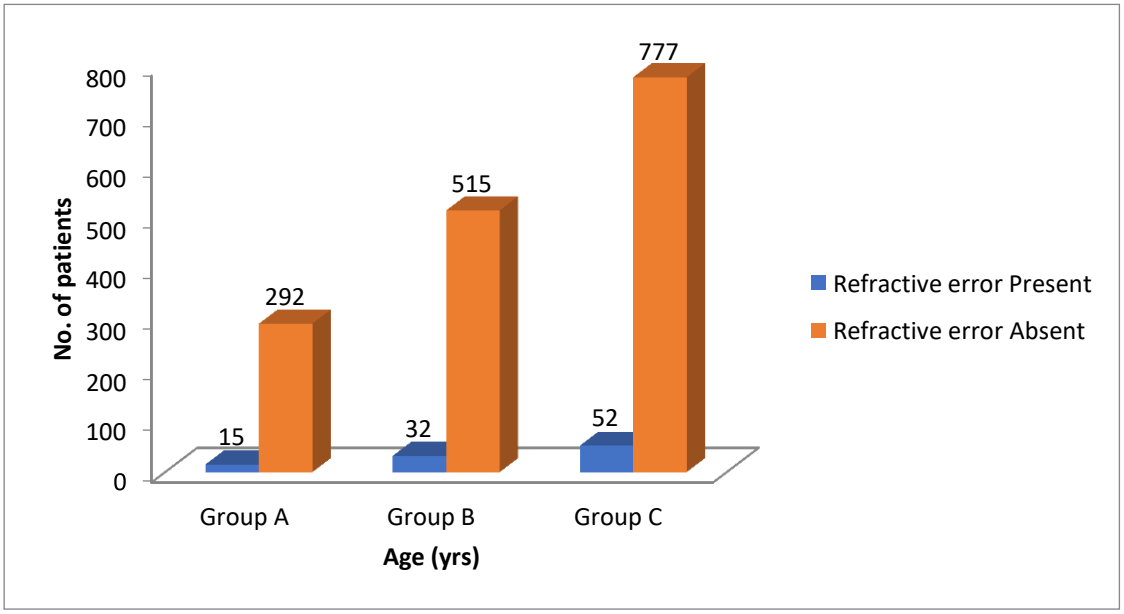

Figure 7: Age distribution of refractive error

Table 4 : Distribution of refractive error in different age groups

Severity of refractive error		Age group						Total	
		Group A		Group B		Group C			
		N	%	N	%	N	%	N	%
Right eye	Mild Myopia	2	13.33	10	31.25	12	22.64	24	24.00
	Moderate myopia	2	13.33	4	12.50	4	7.55	10	10.00
	Severe myopia	1	6.67	3	9.38	6	11.32	10	10.00
	Mild hypermetropia	0	0.00	1	3.13	10	18.87	11	11.00
	Severe hypermetropia	5	33.33	9	28.13	15	28.30	29	29.00
	Mild astigmatism	0	0.00	0	0.00	0	0.00	0	0.00
	Moderate astigmatism	4	26.67	3	9.38	3	5.66	10	10.00
	Severe astigmatism	1	6.67	2	6.25	3	5.66	6	6.00
Left eye	Mild Myopia	2	13.33	9	28.13	12	22.64	23	23.00
	Moderate myopia	3	20.00	7	21.88	5	9.43	15	15.00
	Severe myopia	1	6.67	1	3.13	5	9.43	7	7.00
	Mild hypermetropia	1	6.67	2	6.25	5	9.43	8	8.00
	Severe hypermetropia	4	26.67	10	31.25	19	35.85	33	33.00
	Mild astigmatism	0	0.00	0	0.00	0	0.00	0	0.00
	Moderate astigmatism	3	20.00	1	3.13	5	9.43	9	9.00
	Severe astigmatism	1	6.67	2	6.25	2	3.77	5	5.00

While evaluating the age distribution of refractive errors, group A children were more commonly affected by hypermetropia than myopia and astigmatism, while group B children were more commonly affected by myopia than hypermetropia and group C children had an almost similar proportion of hypermetropia and myopia.

Table 5: Frequency of type of refractive error

Severity of refractive error		No. of eyes	Percentage
Right eye	Emmetropia	1583	94.06
	Mild myopia	24	1.43
	Moderate myopia	10	0.59
	Severe myopia	10	0.59
	Mild hypermetropia	11	0.65
	Severe hypermetropia	29	1.72
	Moderate astigmatism	10	0.59
	Severe astigmatism	6	0.36
Left eye	Emmetropia	1583	94.06
	Mild myopia	23	1.37
	Moderate myopia	15	0.89
	Severe myopia	7	0.42
	Mild hypermetropia	8	0.48
	Severe hypermetropia	33	1.96
	Moderate astigmatism	9	0.53
	Severe astigmatism	5	0.30

We evaluated the frequency of refractive error in either eye. In the right eye, the frequency of severe hypermetropia(1.72%) was the highest, followed by mild myopia (1.43%), mild hypermetropia (0.65%), moderate to severe myopia (0.59%), moderate astigmatism (0.59%) and severe astigmatism (0.36%). Similarly in the left eye frequency of severe hypermetropia was highest (1.96%), followed by mild myopia (1.37%), moderate myopia (0.89%), moderate astigmatism (0.53%), mild hypermetropia (0.48%), severe myopia (0.42%), severe astigmatism (0.30).

Table 6: Prevalence of amblyopia in the screened children

Amblyopia	No. of patients	Percentage
Present	28	1.66
Absent	1655	98.34
Total	1683	100.00

Among the 1683 screened children, the prevalence of amblyopia was found to be 1.66% (n=28).

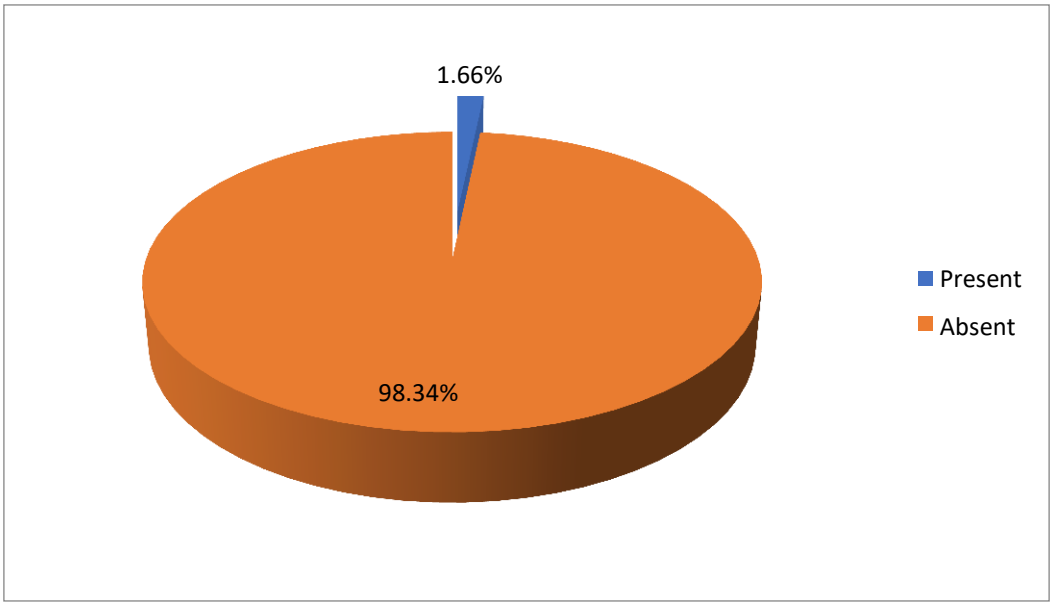

Figure 8: Prevalence of amblyopia in the screened children

Table 7: Age distribution of amblyopia prevalence

Age (yrs)	Amblyopia				Total		P value
	Present		Absent				
	N	%	N	%	N	%	
Group A	5	1.63	302	98.37	307	100	0.957
Group B	10	1.83	537	98.17	547	100	0.714
Group C	13	1.57	816	98.43	829	100	0.762

There was no association of amblyopia with increasing age. The prevalence of amblyopia in group A was 1.63%(n=5)(p=0.957), 1.83%(n=10)(p=0.714) in group B, and 1.57%(n=13)(p=0.762) in group C.

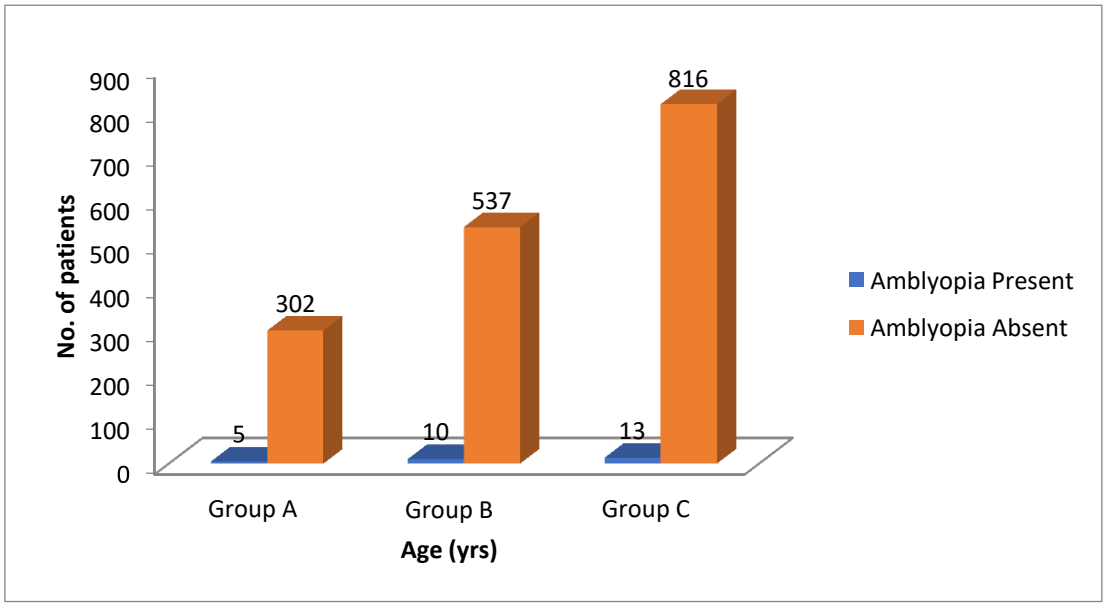

Figure 9: Age distribution of amblyopia prevalence

Table 8: Laterality of amblyopia

Unilateral/Bilateral amblyopia	No. of patients	Percentage	p value
Unilateral	16	57.14	0.499
Bilateral	12	42.86	
Total	28	100.00	--

Unilateral amblyopia was more common than bilateral amblyopia and was seen in 57.14%(n=16)of the children whereas bilateral amblyopia was seen in 42.86%(n=12) of the children(p=0.499).

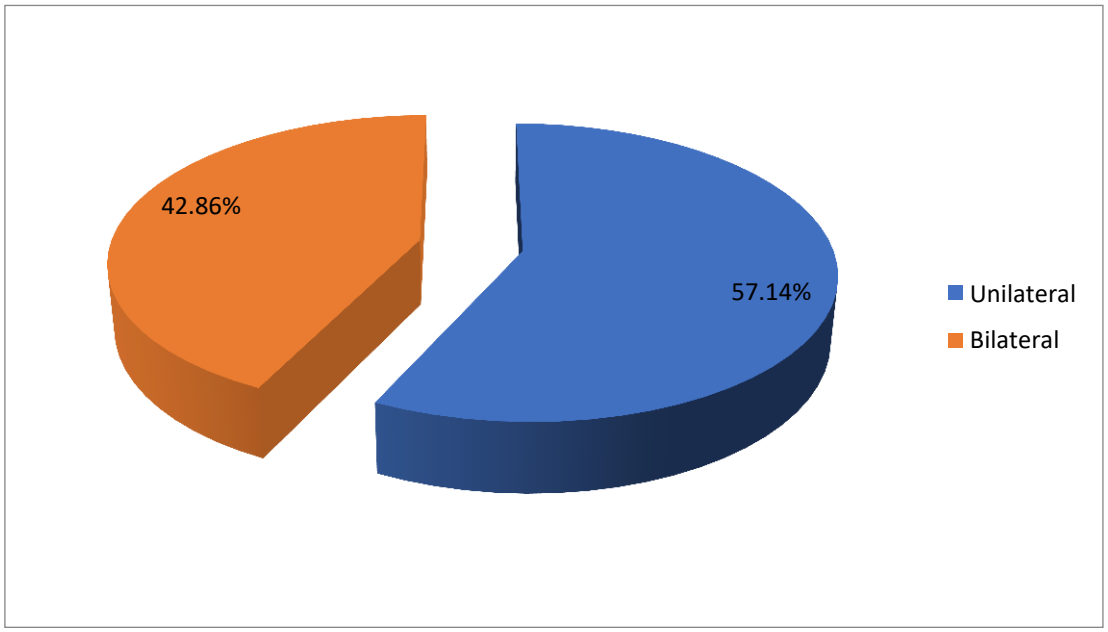

Figure 10: Laterality of amblyopia

Table 9: Ocular risk factors associated with amblyopia

Type of amblyopia	No. of patients	Percentage	p value
Refractive	20	71.43	<0.0001
Strabismic	6	21.43	
Deprivation	2	7.14	
Total	28	100.00	-

While evaluating the ocular pathologies of amblyopia, refractive amblyopia was the most significant risk factor constituting 71.43%(n=20) ($p<0.0001$) followed by strabismic amblyopia which was 21.43%(n=6). The deprivation amblyopia was causative in 7.14%.(n=2) of amblyopes.

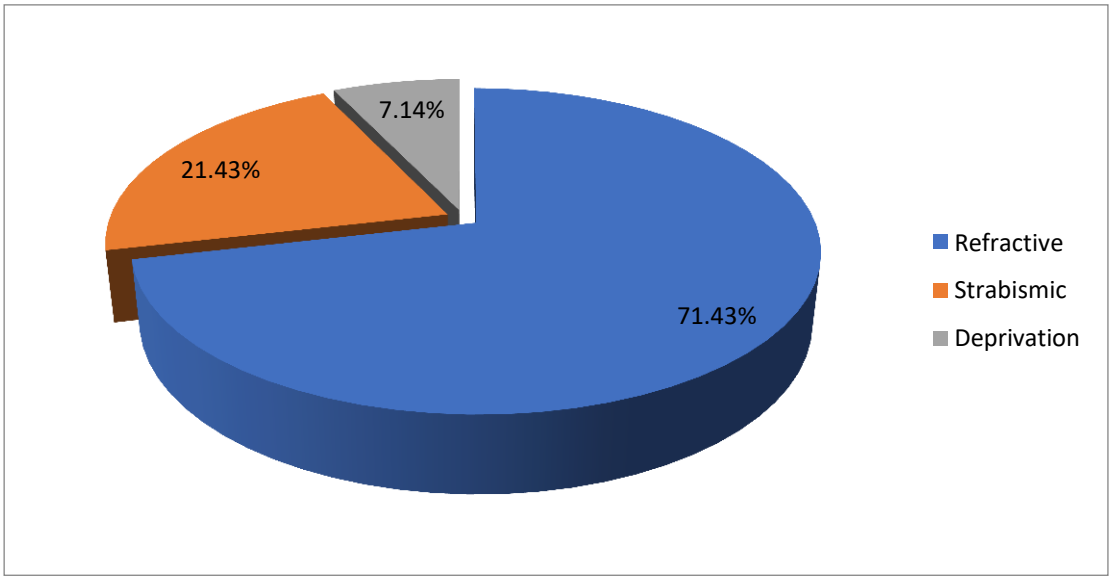

Figure 11: Ocular risk factors associated with amblyopia

Table 10: Distribution of type of refractive error in amblyopia

Type of refractive amblyopia	No. of patients	Percentage	p value
Hypermetropia	7	25	0.05
Myopia	2	7.14	
Anisometropia	19	67.86	
Total	28	100.00	-

Anisometropic amblyopia was a significant risk factor in 67.86%(n=19)(p=0.05) for amblyopia followed by amblyopia caused by hypermetropia which was seen in 25%(n=7) and then myopia 7.14%(n=2).

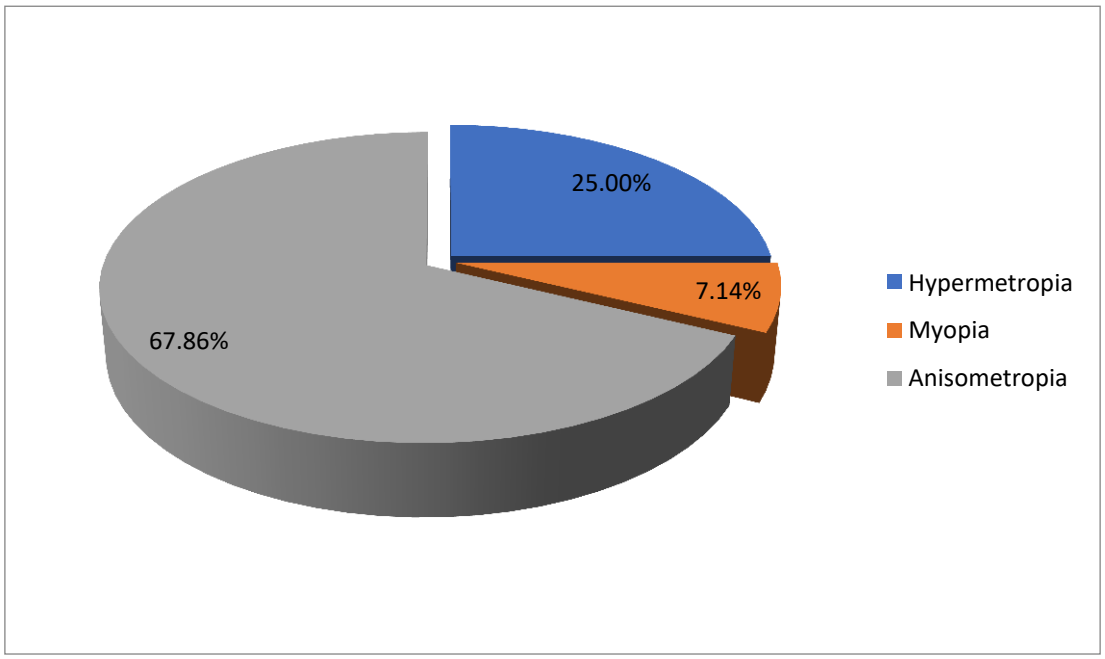

Figure 12: Distribution of type of refractive error in amblyopia

Table 11: Grading of the severity of amblyopia

Severity of amblyopia		No. of eyes	Percentage
Right eye	No amblyopia	1663	98.81
	Mild amblyopia	2	0.12
	Moderate amblyopia	10	0.59
	Severe amblyopia	8	0.48
Left eye	No amblyopia	1662	98.75
	Mild amblyopia	1	0.06
	Moderate amblyopia	11	0.65
	Severe amblyopia	9	0.53

The majority of the children were affected with a moderate grade of amblyopiafollowed by severe amblyopia and then mild amblyopia. The frequency of moderate amblyopia was 10 in right eye and 11 in left eye, severe amblyopia in was 8 the right eye and 9 left eye, while the frequency of mild amblyopia was 2 in the right eye and 1in the left eye.

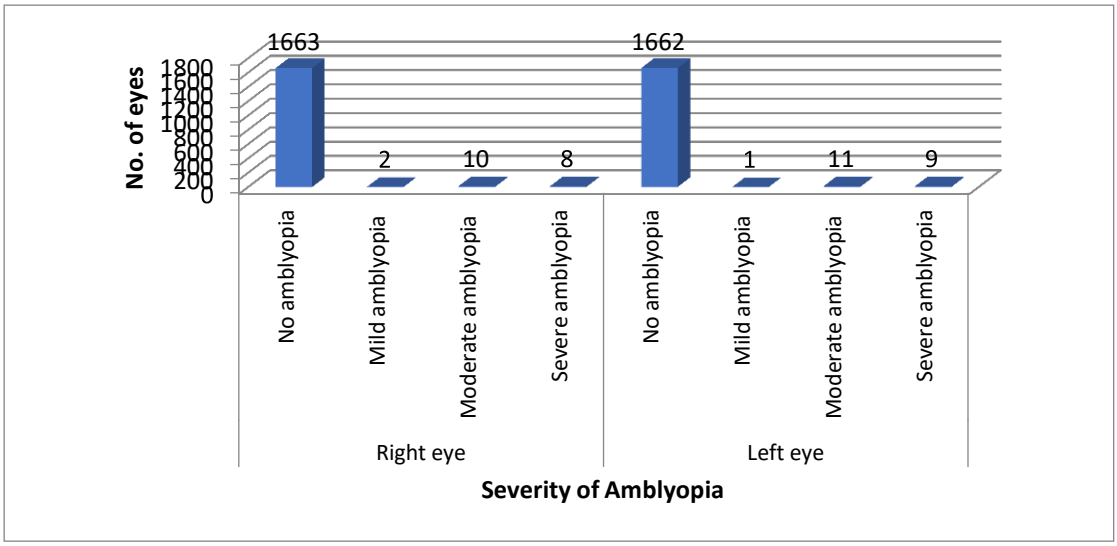

Figure 13: Grading of the severity of amblyopia

Table 12: Distribution of the severity of amblyopia as per age group

Severity of amblyopia		Age group						Total	
		Group A		Group B		Group C			
		N	%	N	%	N	%	N	%
Right eye	Mild	0	0.00	0	0.00	2	25.00	2	10.00
	Moderate	2	50.00	4	50.00	4	50.00	10	50.00
	Severe	2	50.00	4	50.00	2	25.00	8	40.00
Left eye	Mild	0	0.00	0	0.00	1	9.09	1	4.76
	Moderate	4	80.00	2	40.00	5	45.45	11	52.38
	Severe	1	20.00	3	60.00	5	45.45	9	42.86

In group A , there was equal incidence of moderate amblyopia and severe amblyopia in the right eye (n=2). In the left eye incidence of moderate amblyopia(n=4) was higher compared to severe amblyopia(n=1). Group B also had an equal incidence of moderate and severe amblyopia respectively in the right eye(n=4) while in left eye 2 eyes had moderate amblyopia and 3 eyes had severe amblyopia. In group C age group2 eyes were affected equally with mild and severe forms of amblyopia, and 4 eyes were affected with a moderate form of amblyopia whereas in the left eye: 1 eye had mild amblyopia, 5 eyes had moderate and severe amblyopia each respectively.

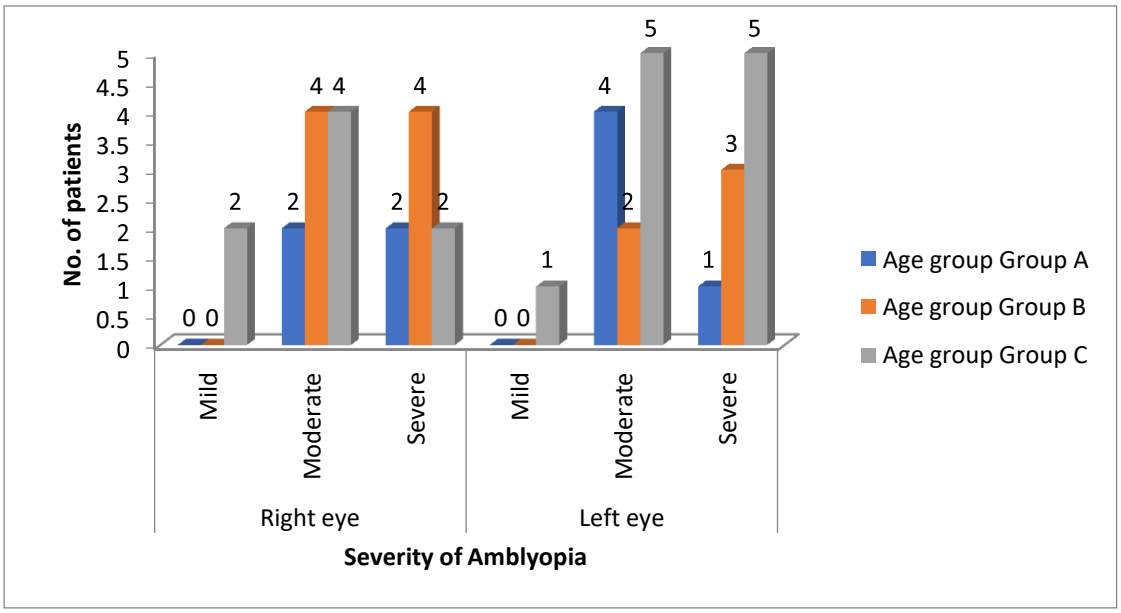

Figure 14: Distribution of the severity of amblyopia as per age group

Table 13: Distribution of refractive error leading to unilateral or bilateral amblyopia

Severity of refractive error		Side of Amblyopia				Total	
		Unilateral		Bilateral			
		N	%	N	%	N	%
Right	Mild Myopia	0	0.00	0	0.00	0	0.00
	Moderate myopia	0	0.00	0	0.00	0	0.00
	Severe myopia	2	2.02	3	0.19	5	0.30
	Mild hypermetropia	4	4.04	1	0.06	5	0.30
	Severe hypermetropia	3	3.03	5	0.32	8	0.48
	Mild astigmatism	0	0.00	0	0.00	0	0.00
	Moderate astigmatism	4	4.04	1	0.06	5	0.30
	Severe astigmatism	3	3.03	2	0.13	5	0.30
Left	Mild Myopia	0	0.00	1	0.06	1	0.06
	Moderate myopia	3	3.03	0	0.00	3	0.18
	Severe myopia	1	1.01	3	0.19	4	0.24
	Mild hypermetropia	1	1.01	0	0.00	1	0.06
	Severe hypermetropia	0	0.00	0	0.00	0	0.00
	Mild astigmatism	7	7.07	5	0.32	12	0.71
	Moderate astigmatism	2	2.02	1	0.06	3	0.18
	Severe astigmatism	2	2.02	2	0.13	4	0.24

Moderate to severe astigmatism was more prevalent in unilateral amblyopia and thus may be an ocular risk factor for unilateral amblyopia.

Table 14: Demographic details of mothers at conception

Variables	Mean	SD
Age at conception	22.30	4.30
Weight at conception	55.60	6.41
Height	153.76	10.82
BMI	24.39	4.46

The demographic details of the mother at conception were studied. The mean age for mothers‟ conception was 22.30±4.30 years, the mean weight at conception was 55.60±6.41kg, and the mean height at conception was 153.76±10.82cm. The average BMI was 24.39±4.46.

Table 15: Association of BMI with amblyopia

BMI (kg/m2)	Amblyopia				Total		p value
	Present		Absent				
	N	%	N	%	N	%	
<18.5	1	3.57	131	7.92	132	7.84	0.719
18.5-24.9	11	39.29	793	47.92	804	47.77	0.364
25-29.9	14	50.00	507	30.63	521	30.96	**0.027***
30-34.5	2	7.14	210	12.69	212	12.60	0.567
>35	0	0.00	14	0.85	14	0.83	1.000
Total	28	100.00	1655	100.00	1683	100.00	-

On comparing BMI at conception with amblyopia, the incidence of amblyopia was 3.57% in BMI range <18.5(p=0.719), 39.29% amblyopia in BMI 18.5-24.9(p=0.364), 50% amblyopia in BMI 25 - 29.9(p=0.027), 7.14% amblyopia in BMI 30-34.5(0.567), of which a significant association of amblyopia was noted with the pre-obese range BMI of 25-29.9 (p = 0.027).

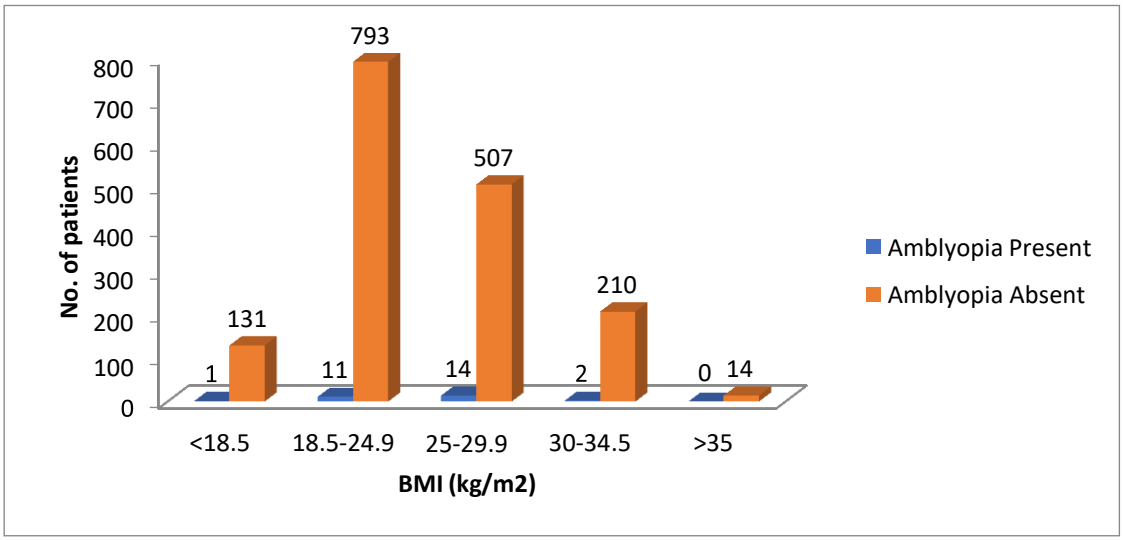

Figure 15: Association of BMI with amblyopia

Table 16: Association of gestational age at birth with amblyopia

Gestational age	Amblyopia				Total		P value
	Present		Absent				
	N	%	N	%	N	%	
Moderately pre-term	10	35.71	29	1.75	10	35.71	**<0.0001***
Late Pre-term	4	14.29	310	18.73	4	14.29	0.549
Term	14	50.00	1316	79.52	14	50.00	**0.001***
Total	28	100.00	1655	100.00	28	100.00	-

We found 35.71% (n=10) of the children had a history of moderately preterm birth(p<0.001), 14.29%(n=4) were late preterm (p=0.549) and 50%(n=14) had full-term birth, of which there was a significant association between moderately preterm birth and amblyopia.

Figure 16: Association of gestational age at birth with amblyopia

Table 17: Birth weight association with amblyopia

Birth weight	Amblyopia				Total		P value
	Present		Absent				
	N	%	N	%	N	%	
VLBW	2	7.14	2	0.12	2	7.14	**0.001***
LBW	16	57.14	64	3.87	16	57.14	**<0.0001***
Normal	10	35.71	1571	94.92	10	35.71	**<0.0001***
Overweight	0	0.00	18	1.09	0	0.00	1.000
Total	28	100.00	1655	100.00	28	100.00	-

We found 7.14%(n=2) had very low birth weight (p=0.001),57.14%(n=16) had low birth weight(p<0.001) and 35.71%(n=10) had normal birth weight(p<0.001).We found a significant association between low birth weight and amblyopia.

Table 18: Association of ocular pathology at birth and amblyopia

Ocular pathology at birth	Amblyopia				Total		P value
	Present		Absent				
	N	%	N	%	N	%	
Outward deviation of LE birth	1	3.57	0	0.00	1	0.06	0.016 (S)
None	27	96.43	1655	100.00	1682	99.94	
Total	28	100.00	1655	100.00	1683	100.00	-

Ocular pathology at birth was seen in 3.57%(n=1) of children, which also had a significant association with amblyopia (p=0.016).

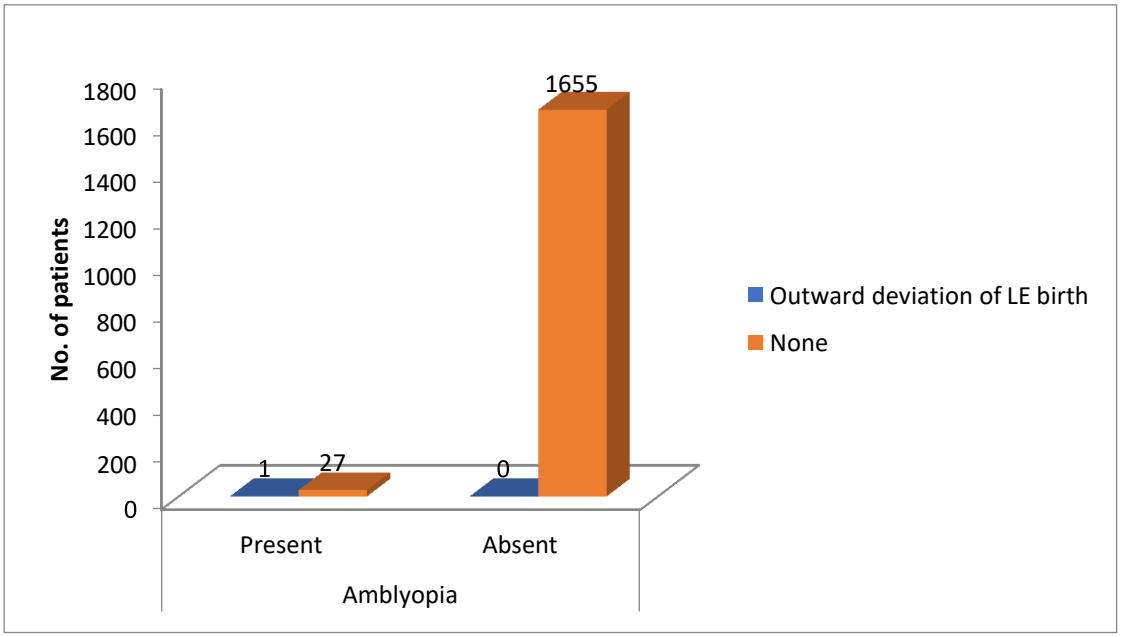

Figure 17: Association of ocular pathology at birth and amblyopia

Table 19: Frequency of postnatal complications with amblyopia

Post natal complications	Amblyopia				Total		P value
	Present		Absent				
	N	%	N	%	N	%	
No complications	20	71.43	1653	99.88	1673	99.41	**<0.0001***
Birth asphyxia	1	3.57	2	0.12	3	0.18	**0.049***
Respiratory distress	5	17.86	0	0.00	5	0.30	**<0.0001***
Neonatal jaundice	2	7.14	0	0.00	2	0.12	**0.0003***
Total	28	100.00	1655	100.00	1683	100.00	-

Birth asphyxia was seen in 3.57%(n=1) of the children (p=0.049), 18.86%(n=5) had respiratory distress (p<0.0001) and 7.14% (n=2) had neonatal jaundice. Our study showed a significant association between post natal complications and amblyopia.

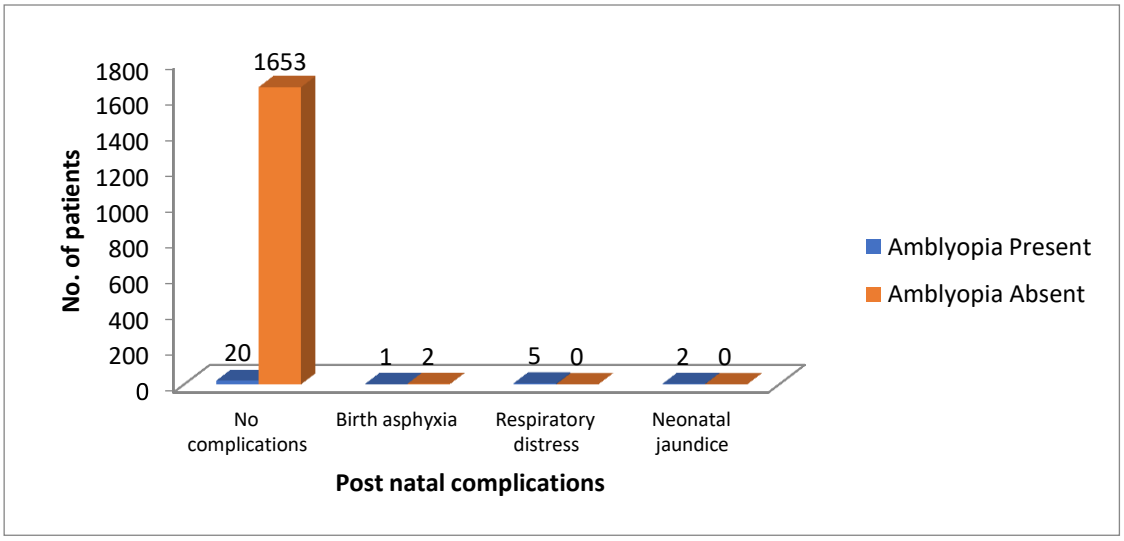

Figure 18: Postnatal of postnatal complications with amblyopia

DISCUSSION

DISCUSSION

Amblyopia is the most common cause of monocular visual impairment in children. In our study, we screened 1683 children in which the prevalence of amblyopia was found to be 1.66%. The majority of the studies had a prevalence ranging from 0.8-3%. The table-20 listed below shows the prevalence of amblyopia that has been evaluated in different studies. Different values of prevalence were obtained due to variations of the age group examined and the difference in the study population.

Table 20 : Prevalence of amblyopia in the pediatric population in the listed studies

Study	Age of patients	No of patients	Prevalence
Sydney Pediatric Eye Disease Study (Pai et al)	6-72 months	1422	1.9
Prevalence & etiology of Amblyopia IN Southern India (Ganekal et al)	5-15years	4020	1.1%
Strabismus ,Amblyopia and Refractive error in Singaporean Preschoolers Study (STARS) (Dirani M et al)	30-72 months	3009	0.8%
Prevalence of Amblyopia among school children in Faridabad (Bhatnagar et al)	6-16 years	2370	1.39%
Baltimore Pediatric Eye Disease Study (Freidman et al)	30-72months	2546	0.8-1.8%
Prevalence of amblyopia and patterns of refractive error in amblyopic children in tertiary center of Nepal (Sapkota K et al)	3-13years	62,633	0.7%
Prevalence and risk factors of amblyopia among refractive errors in an Eastern European Population (Mocanu V et al)	5-16years	1231	2.8%

In our study, the age group of screening was from 3-12 years which was within the age of plasticity of amblyopia. Screening during this period of plasticity provided us with the advantage of early intervention which also affects the prognosis of the treatment. The majority of the studies did not include 3-4 years of age and most of the Indian studies were of the age group five years and above like that by Ganekal et al, [8] who screened children from 5-15 years; Bhatnagar et al, [9] who screened children from 6-16 years age group and also Gupta M et al ,[68] who screened children from 5-15 years. While some studies like that of Freidman et al [72], Dirani M et al[70] screened children from 30-72 months. We screened preschool children and evaluated them for amblyopia which was a challenging task. Since screening in this preschool children is cumbersome, there is a paucity of Indian literature on screening of children in the age group of 3-4 years.

Our study had no sex predilection(p=0.255) unlike some studies like Sapkota K et al [11] and Lee et al[73] which had a male predilection for amblyopia. Also, some studies like Park et al [74] , and Chua et al[75] showed female predilection.

The second aim of our study was to find and identify risk factors for amblyopia. In our study, we found a significant association of amblyopia with pre-term birth(p<0.0001) and low birth weight (p<0.0001).The results were identical to the study done by Robaei D et al who screened 6 years old school-going children in Sydney. The study showed a significant correlation between amblyopia and low birth weight (p=0.03) and preterm birth (p=0.001). [76,77] Similarly the SPEDS study that was also conducted on Australian preschoolers also found a significant association between preterm birth and amblyopia (< 37 weeks, p=0.008).[71] Similarly, in research conducted in the United Kingdom, low birth weight and gestational age were found tobe risk factors for amblyopia. [78] A study done in the subpopulation of Asia i.e., the Iranian study showed that the risk of amblyopia was as high as seven times in those with preterm birth (OR, 7.11; 95% CI 2.28–22.14) and was almost six times in those with low birth weight (OR, 6.49; 95% CI 2.29–18.32). [79]

In contrast, the Singapore study found no association between amblyopia and prematurity [70]. In the Australian preschool children study done by Pai et al, amblyopia was not associated either with low birth weight <2500gm (OR ,2.61;95% CI 0.33-20.87) nor with prematurity <37weeks (OR ,1.81;95%CI 0.37-8.75).[71]

We also analyzed the BMI of mothers at pre-conception period and we found that being BMI (25-29.9) had the highest association with amblyopia and was found to be significant (p=0.027). Comparable results were also seen in a study done by Mocanu V et al which showed BMI both below 18.5 and above 25 showed a significant associated with amblyopia (p<0.001) [7]

In our study, the most common ocular cause of amblyopia was refractive amblyopia (71.43%) followed by strabismic and then deprivation amblyopia. Similarly, a study done on Singaporean Chinese children showed refractive error in 85% of cases of amblyopia. [70] In a multiethnic study done in African American and Hispanic children i.e., MEPEDS study, refractive amblyopia accounted for 78%. [80]

In our study, anisometropia was found to be a major risk factor for amblyopia and was seen in 67.86% of the children. Our results were in comparable with the studies conducted by Mocanu V et al [7] and by Ganekal et al, [8] Pascual M et al, [67] which also concluded anisometropic amblyopia to be the most common refractive risk factorfor amblyopia. Contrary to our study, Menon et al found strabismic amblyopia in 37%of the 733 total eyes that were evaluated and concluded strabismic amblyopia was the most common kind.[81]

In our study, we recorded 21.43% of children as strabismic amblyopes. Strabismus, though not the most common cause of amblyopia, it‟s still a significant risk factor. The study done in the multiethnic populations of the African American and Hispanic population concluded strabismus though less common than anisometropia inpreschool children with amblyopia, strabismus was still a significant component in the development of amblyopia. [70,80] Similarly the study done on Australian preschool children, strabismic amblyopia was found in 27% of the children. [71]

In ocular pathology, only 1 child with amblyopia had esotropia at birth, which had a significant association (p=0.016). Other than esotropia, no other congenital ocular pathology was noted in amblyopes. Though the number of amblyopes with congenital ocular pathologies are very less, but a significant association establishes the fact that congenital esotropia is a significant risk factor for the development of amblyopia. There is paucity of literature based on ocular pathology at birth. . In a study

conducted by Mocanu et al [7] significant association of CNLDO with amblyopia was found(n=14).

In our study, we noted birth asphyxia, respiratory distress and neonatal jaundice to be significantly associated with amblyopia. Therefore, children with these postnatal complications can be followed up closely with regular ophthalmological examination for the prevention of amblyopia. However, we could not find any similar literature based on the association of amblyopia with post-natal complications. A study conducted by Pan CW et al showed a significant association of amblyopia in children who had APGAR scores less than seven. [82]

In our study, the frequency distribution of type of refractive error with respect to amblyopia differed between the two eyes. However, on evaluating the cumulative frequency for different types of refractive error (myopia, hypermetropia and astigmatism) for both eyes, it was noted that the frequency of myopia (n=13) was 23.21% and hypermetropia (n=14) was 25% ,which were almost similar whereas for astigmatism it was 51.78% and was the the highest (n=29). A major conclusion that can be drawn here is that astigmatism is more amblyogenic than myopia or hypermetropia. Similarly, both hyperopia (66.7% of cases) and astigmatism (48.1%), with or without anisometropia, were found as major amblyogenic risk factors in the study by Pai AS et al. [71] In a study by Pascual M et al concluded that hyperopia>2D, astigmatism >1D, anisometropia >0.5D were significant risk factors of refractive amblyopia.[67] We found astigmatism was more frequent in unilateral amblyopes and thus may be a risk factor for unilateral amblyopia. Hypermetropia was common in bilateral amblyopia, hence may be a risk factor for bilateral amblyopia. Similar findings by Hendler K et al showed astigmatism and hyperopia were more prevalent in unilateral amblyopes and hyperopia more prevalent in bilateral amblyopes.[10]

In our study majority of the eyes affected by amblyopia had a moderate degree of amblyopia(n=21) followed by severe amblyopia (n=17) and mild amblyopia(n=3). However most studies in their literature did not mention the severity of amblyopia that affected their study population. Some studies like that of Sapkota K et al found mild to moderate amblyopia in 60% of their study population.[11] The evaluation is important as the treatment depends on the severity of amblyopia.

In our study, we studied the prevalence of amblyopia as well as the risk factors that were associated with it. We emphasized on both the ocular and non-ocular risk factors of amblyopia. The age of screening was within the age of plasticity. So early diagnosis had the advantage of early treatment and better prognosis. Secondly, screening is important as it can reduce the prevalence of amblyopia when diagnosedat an early age. The children diagnosed with refractive errors during screening were prescribed glasses and the children diagnosed with refractive amblyopia were advised ocular patching along with glasses and were followed up at regular intervals for evaluation of improvement. The parents and the teachers were made aware of the importance of screening and the risk factors that may lead to amblyopia. They were also counseled about treatment compliance and the ill effects of non compliance which can lead to long-term ocular morbidity. The majority of the studies have screened either very young children belonging from 30-72 months or from 5 yearsand above. Some studies either have just evaluated the ocular factors or evaluated only non-ocular risk factors. Intervention and awareness while studying the prevalence and risk factors for amblyopia were not mentioned in their studies whereas in our study ,we explained the teachers about the importance of screening , and how early diagnosis and intervention can lead to improvement in visual acuity and reduce the prevalence of amblyopia . The children diagnosed with amblyopia , intervention was taken to treat the cause of amblyopia and then the children were followed up at regular intervals for evaluation of improvement .

CONCLUSION & LIMITATIONS

CONCLUSION

1. A total of 1863 children were screened of which 1.66% were diagnosed with amblyopia and 5.88% were diagnosed with refractive error.
2. The mean age of screening was 8.92±2.20 years
3. The mean of best corrected visual acuity in the right eye was 0.01±-0.07 and the left eye was 0.01±0.08.
4. Refractive error in the age group A was 15.15%(n=15) children, in group B was 32.32%(n=32) children, and in group C was 52.53% (n=52) children were diagnosed with a refractive error when screened.
5. In group A hypermetropia, in group B myopia, and in group C both hypermetropia and myopia were the most common refractive errors.
6. In group A prevalence of amblyopia was 1.63%(n=5),in group B was 1.83%(n=10) and in group C was 1.57%(n=13).There was no significant association of amblyopia with increasing age.
7. There was no sex predilection for amblyopia.
8. Unilateral amblyopia was more prevalent than bilateral amblyopia.
9. Amongst the ocular pathologies of amblyopia refractive amblyopia was the most significant risk factor.
10. Anisometropic amblyopia was the most significant refractive amblyopia which constituted about 67.86%.
11. Most of the children affected by amblyopia had a moderate grade of severity of amblyopia.
12. Severe astigmatism may be a risk factor for anisometropic amblyopia.
13. The mean age for mothers‟ conception was 22.30±4.30 years, weight at conception was 55.60±6.41kg, height at conception 153.76±10.82cm and average BMI was 24.39±4.46.
14. We found a significant association between the pre-obese range of BMI and of amblyopia.
15. Significant association between moderately preterm birth and amblyopia. ($p<0.0001$)
16. Significant association between low birth weight and amblyopia. ($p<0.0001$)
17. Presence of ocular pathology at birth also had a significant association with amblyopia.

18. The association between post-natal complications and amblyopia was found to be significant.

LIMITATIONS

1. The data obtained from the parents (e.g., maternal smoking history, family history of amblyopia, the weight of the mother at preconception) may be questionable.
2. Our study population was small .
3. We excluded children who could not complete visual acuity testing, who could indeed be amblyopic.
4. We excluded children who were absent on the day of school screening.
5. Few children who were enlisted to follow up in out-patient department , did not show up.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Wallace DK, Morse CL, Melia M, Sprunger DT, Repka MX, Lee KA, Christiansen SP. Pediatric eye evaluations preferred practice Pattern®: I. vision screening in the primary care and community setting; II. comprehensive ophthalmic examination. Ophthalmology. 2018 Jan 1;125(1): P184-227
2. Gopal SK, Kelkar J, Kelkar A, Pandit A. Simplified updates on the pathophysiology and recent developments in the treatment of amblyopia: A review. Indian journal of ophthalmology. 2019 Sep;67(9):1392.
3. Hensch TK, Quinlan EM. Critical periods in amblyopia. Visual neuroscience. 2018 Jan;35: E014.
4. Hillis A, Flynn JT, Hawkins BS. The evolving concept of amblyopia: a challenge to epidemiologists. American journal of epidemiology. 1983 Aug 1;118(2):192-205.
5. Pascual M, Huang J, Maguire MG, Kulp MT, Quinn GE, Ciner E, Cyert LA, Orel-Bixler D, Moore B, Ying GS, Vision in Preschoolers (VIP) Study Group. Risk factors for amblyopia in the vision in preschoolers‟ study. Ophthalmology. 2014 Mar 1;121(3):622-9.
6. Khan T. Is there a critical period for amblyopia therapy? results of a study on older anisometropic amblyopes. Journal of clinical and diagnostic research: JCDR. 2015 Aug;9(8):NC01.
7. Mocanu V, Horhat R. Prevalence and risk factors of amblyopia among refractive errors in an Eastern European population. Medicina. 2018 Mar;54(1):6.
8. Ganekal S, Jhanji V, Liang Y, Dorairaj S. Prevalence and etiology of amblyopia in Southern India: results from screening of school children aged 5–15 years. Ophthalmic epidemiology. 2013 Aug 1;20(4):228-31.
9. Bhatnagar KR, Kumar A, Kumar R. Prevalence of Amblyopia among School Children in Faridabad, Haryana.
10. Hendler K, Mehravaran S, Lu X, Brown SI, Mondino BJ, Coleman AL. Refractive errors and amblyopia in the UCLA preschool vision program; first year results. American Journal of Ophthalmology. 2016 Dec 1; 172:80-6.

11. Sapkota K, Pirouzian A, Matta NS. Prevalence of amblyopia and patterns of refractive error in the amblyopic children of a tertiary eye care center of Nepal. Nepalese Journal of Ophthalmology. 2013 Mar 25;5(1):38-44

12. Denison RN, Vu AT, Yacoub E, Feinberg DA, Silver MA. Functional mapping of the magnocellular and parvocellular subdivisions of human LGN. Neuroimage. 2014 Nov 15;102:358-69.

13. Purves D, editor. Neuroscience. 3rd ed. Sunderland, Mass: Sinauer Associates, Publishers; 2004. 1 p.

14. Le Vay S, Wiesel TN, Hubel DH. The development of ocular dominance columns in normal and visually deprived monkeys. J Comp Neurol 1980;191:1-51.

15. O"Kusky J, Colonnier M. Postnatal changes in the number of neurons and synapses in the visual cortex (area 17) of the macaque monkey: A stereological analysis in normal and monocularly deprived animals. J Comp Neurol 1982;210:291-306.

16. Horton JC. Cytochrome oxidase patches: A new cytoarchitectonic feature of monkey visual cortex. Philos Trans R Soc Lond B Biol Sci 1984;304:199-253

17. Espinosa JS, Stryker MP. Development and plasticity ofthe primary visual cortex. Neuron 2012;75:230-49.

18. Le Magueresse C, Monyer H. GABAergic interneurons shape the functional maturation of the cortex. Neuron 2013;77:388-405

19. Sengpiel F. Plasticity of the visual cortex and treatment of amblyopia. Curr Biol 2014;24:R936-40.

20. Orssaud C. Amblyopia. J Fr Ophtalmol 2014;37:486-96.

21. Gattass R, Nascimento-Silva S, Soares JG, Lima B, Jansen AK, Diogo AC, Farias MF, Botelho MM, Mariani OS, Azzi J, Fiorani M. Cortical visual areas in monkeys: location, topography, connections, columns, plasticity and cortical dynamics. Philosophical Transactions of the Royal Society B: Biological Sciences. 2005 Apr 29;360(1456):709-31.

22. Kiorpes L, McKeet SP. Neural mechanisms underlying amblyopia. Current opinion in neurobiology. 1999 Aug 1;9(4):480-6.

23. Daw NW. Critical periods and amblyopia. Archives of ophthalmology. 1998 Apr 1;116(4):502-5.

24. Epelbaum M, Milleret C, Buisseret P, Duffer JL. The sensitive period for strabismic amblyopia in humans. Ophthalmology. 1993 Mar 1;100(3):323-7.

25. Wallace DK, Repka MX, Lee KA, Melia M, Christiansen SP, Morse CL, Sprunger DT. Amblyopia preferred practice pattern®. Ophthalmology. 2018 Jan 1;125(1):P105-42.

26. Abrahamsson M, Sjöstrand J. Natural history of infantile anisometropia. British Journal of Ophthalmology. 1996 Oct 1;80(10):860-3.

27. Townshend AM, Holmes JM, Evans LS. Depth of anisometropic amblyopia and difference in refraction. American journal of ophthalmology. 1993 Oct 1;116(4):431-6.

28. Pediatric Eye Disease Investigator Group. A comparison of atropine and patching treatments for moderate amblyopia by patient age, cause of amblyopia, depth of amblyopia, and other factors. Ophthalmology. 2003 Aug 1;110(8):1632-7.

29. Fledelius H. Prematurity and the eye. Ophthalmic 10-year follow-up of children of low and normal birth weight. Acta Ophthalmol Suppl 1976;128:3- 245.

30. Kitchen WH, Richards A, Ryan MM, et al. A longitudinal study of very low-birthweight infants. II: Results of controlled trial of intensive care and incidence of handicaps. Dev Med Child Neurol 1979;21:582-9.

31. Abrahamsson M, Magnusson G, Sjostrand J. Inheritance of strabismus and the gain of using heredity to determine populations at risk of developing strabismus. Acta Ophthalmol Scand 1999;77:653-7.

32. Maumenee IH, Alston A, Mets MB, et al. Inheritance of congenital esotropia. Trans Am Ophthalmol Soc 1986;84:85-93.

33. van Hof-Van Duin J, Evenhuis-van Leunen A, Mohn G, et al. Effects of very low birth weight (VLBW) on visual development during the first year after term. Early Hum Dev 1989;20:255-66.

34. Hakim RB, Tielsch JM. Maternal cigarette smoking during pregnancy. A risk factor for childhood strabismus. Arch Ophthalmol 1992;110:1459-62.

35. Bruce BB, Biousse V, Dean AL, Newman NJ. Neurologic and ophthalmic manifestations of fetal alcohol syndrome. Rev Neurol Dis 2009;6:13-20.

36. Dadeya S, Vats P, Malik KP. Levodopa/carbidopa in the treatment of amblyopia. Journal of Pediatric Ophthalmology & Strabismus. 2009;46(2):87-90.

37. Williams C, Northstone K, Harrad RA, et al. ALSPAC Study Team. Amblyopia treatment outcomes after screening before or at age 3 years: followup from randomised trial. BMJ 2002;324:1549

38. American Association for Pediatric Ophthalmology and Strabismus and American Academy of Ophthalmology. Joint Policy Statement. Vision Screening for Infants and Children. San Francisco, CA: American Academy of Ophthalmology; 2007. Available at: http://one.aao.org/CE/PracticeGuidelines/ClinicalStatements.aspx. Accessed October 21, 2011.

39. Eibschitz-Tsimhoni M, Friedman T, Naor J, et al. Early screening for amblyogenic risk factors lowers the prevalence and severity of amblyopia. J AAPOS 2000;4:194-9.

40. Pediatric Eye Disease Investigator Group. A randomized trial of atropine vs. patching for treatment of moderate amblyopia in children. Arch Ophthalmol 2002;120:268-78.

41. Scheiman MM, Hertle RW, Beck RW, Edwards AR, Birch E, Cotter SA, et al. Randomized trial of treatment of amblyopia in children aged 7 to 17 years. Arch Ophthalmol 2005;123:437-47.

42. Chen PL, Chen JT, Tai MC, Fu JJ, Chang CC, Lu DW (2007) Anisometropic amblyopia treated with spectacle correction alone: possible factors predicting success and time to start patching. Am J Ophthalmol 143:54–60

43. Chen AM, Cotter SA. The amblyopia treatment studies: implications for clinical practice. Advances in ophthalmology and optometry. 2016 Aug 1;1(1):287-305.

44. Foley-Nolan A, McCann A, O'Keefe M (1997) Atropine penalisation versus occlusion as the primary treatment for amblyopia. Br J Ophthalmol 81:54–57.

45. Iuvone PM, Tigges M, Fernandes A, Tigges J. Dopamine synthesis and metabolism in rhesus monkey retina: Development, aging, and the effects of monocular visual deprivation. Vis Neurosci 1989;2:465-71.

46. Sofi IA, Gupta SK, Bharti A, Tantry TG. Efficiency of the occlusion therapy with and without levodopa-carbidopa in amblyopic children-A tertiary care centre experience. Int J Health Sci 2016;10:249-57.

47. Campos EC, Schiavi C, Benedetti P, Bolzani R, Porciatti V. Effect of citicoline on visual acuity in amblyopia: Preliminary results. Graefes Arch Clin Exp Ophthalmol 1995;233:307-12.

48. Pediatric Eye Disease Investigator Group (2009) Pharmacological plus optical penalization treatment for amblyopia: results of a randomized trial. Arch Ophthalmol 127:22–30.

49. Kaye SB, Chen SI, Price G, Kaye LC, Noonan C, Tripathi A, Ashwin P, Cota N, Clark D, Butcher J (2002) Combined optical and atropine penalization for the treatment of strabismic and anisometropic amblyopia. J AAPOS 6:289– 293.

50. Laria C, Piñero DP, Alió JL (2011) Characterization of Bangerter filter effect in mild and moderate anisometropic amblyopia: predictive factors for thevisual outcome. Graefes Arch Clin Exp Ophthalmol 249:759–766.

51. Agervi P, Kugelberg U, Kugelberg M, Simonsson G, Fornander M,Zetterström C (2009) Treatment of anisometropic amblyopia with spectacles or in combination with translucent Bangerter filters. Ophthalmology 116:1475–1480.

52. BenEzra O, Herzog R, Cohen E, Karshai I, BenEzra D (2007) Liquid crystal glasses: feasibility and safety of a new modality for treating amblyopia. Arch Ophthalmol 125:580–581.

53. Wang J, Neely DE, Galli J, Schliesser J, Graves A, Damarjian TG, Kovarik J, Bowsher J, Smith HA et al (2016) A pilot randomized clinical trial of intermittent occlusion therapy liquid crystal glasses versus traditional patching for treatment of moderate unilateral amblyopia. J AAPOS 20:326–331.

54. Gibson EJ (1963) Perceptual learning. Annu Rev Psychol 14:29– 56 .

55. Campbell FW, Hess RF, Watson PG, Banks R (1978) Preliminary results of a physiologically based treatment of amblyopia. Br J Ophthalmol 62:748–755.

56. Chen Z, Li J, Liu J, Cai X, Yuan J, Deng D, Yu M (2016) Monocularperceptual learning of contrast detection facilitates binocular combination in adults with anisometropic amblyopia. Sci Rep 6:20187.

57. Ooi TL, Su YR, Natale DM, He ZJ (2013) A push-pull treatment for strengthening the „lazy eye" in amblyopia. Curr Biol 23:309– 310.

58. Buckley D, Codina C, Bhardwaj P, Pascalis O (2010) Action video game players and deaf observers have larger Goldmann visual fields. Vis Res 50:548–556.

59. Li R, Polat U, Makous W, Bavelier D (2009) Enhancing the contrast sensitivity function through action video game training. Nat Neurosci 12:549– 551.

60. Green CS, Bavelier D (2007) Action-video-game experience alters the spatial resolution of vision. Psychol Sci 18:88–94 Graefes Arch Clin Exp Ophthalmol.

61. Green CS, Bavelier D (2003) Action video game modifies visual selective attention. Nature 423:534–537.

62. Foss AJ (2017) Use of video games for the treatment of amblyopia. Curr Opin Ophthalmol 28:276–281.

63. Li J, Thompson B, Deng D, Chan LY, Yu M, Hess RF (2013) Dichoptic training enables the adult amblyopic brain to learn. Curr Biol 23:308–309.

64. Hess RF, Mansouri B, Thompson B (2010) A new binocular approach to the treatment of amblyopia in adults well beyond the critical period of visual development. Restor Neurol Neurosci 28: 793–802.

65. Paysse EA, Tychsen L, Stahl E (2012) Pediatric refractive surgery: corneal and intraocular techniques and beyond. J AAPOS 16:291– 297.

66. Stahl ED (2017) Pediatric refractive surgery. Curr Opin Ophthalmol 28:305–309.

67. Pascual M, Huang J, Maguire MG, Kulp MT, Quinn GE, Ciner E, Cyert LA, Orel-Bixler D, Moore B, Ying GS, Vision in Preschoolers (VIP) Study Group. Risk factors for amblyopia in the vision in preschoolers study. Ophthalmology. 2014 Mar 1;121(3):622-9.

68. Gupta M, Rana SK, Mittal SK, Sinha RN. Profile of amblyopia in school going (5-15 years) children at state level referral hospital in Uttarakhand. Journal of clinical and diagnostic research: JCDR. 2016 Nov;10(11):SC09.

69. Afsari S, Rose KA, Gole GA, Philip K, Leone JF, French A, Mitchell P. Prevalence of anisometropia and its association with refractive error and

amblyopia in preschool children. British Journal of Ophthalmology. 2013 Sep 1;97(9):1095-9.

70. Dirani M, Chan YH, Gazzard G, Hornbeak DM, Leo SW, Selvaraj P, Zhou B, Young TL, Mitchell P, Varma R, Wong TY. Prevalence of refractive error in Singaporean Chinese children: the strabismus, amblyopia, and refractive error in young Singaporean Children (STARS) study. Investigative ophthalmology & visual science. 2010 Mar 1;51(3):1348-55.

71. Pai AS, Rose KA, Leone JF, Sharbini S, Burlutsky G, Varma R, Wong TY, Mitchell P. Amblyopia prevalence and risk factors in Australian preschool children. Ophthalmology. 2012 Jan 1;119(1):138-44.

72. Friedman DS, Repka MX, Katz J, Giordano L, Ibironke J, Hawse P, Tielsch JM. Prevalence of amblyopia and strabismus in white and African American children aged 6 through 71 months: the Baltimore Pediatric Eye DiseaseStudy. Ophthalmology. 2009 Nov 1;116(11):2128-34.

73. Lee CE, Lee YC, Lee SY. Factors influencing the prevalence of amblyopia in children with anisometropia. Korean Journal of Ophthalmology. 2010 Aug 1;24(4):225-9.

74. Park KA, Oh SY. Analysis of spectral-domain optical coherence tomography measurements in amblyopia: a pilot study. British Journal of Ophthalmology. 2011 Dec 1;95(12):1700-6.

75. Chua B, Mitchell P. Consequences of amblyopia on education, occupation, and long-term vision loss. British Journal of Ophthalmology. 2004 Sep 1;88(9):1119-21.

76. Robaei D, Rose KA, Kifley A, Cosstick M, Ip JM, Mitchell P. Factors associated with childhood strabismus: findings from a population-based study. Ophthalmology. 2006 Jul 1;113(7):1146-53.

77. Robaei D, Rose KA, Ojaimi E, Kifley A, Martin FJ, Mitchell P. Causes and associations of amblyopia in a population-based sample of 6-year-old Australian children. Archives of ophthalmology. 2006 Jun 1;124(6):878-84.

78. O"Connor AR, Stewart CE, Singh J, Fielder AR. Do infants of birth weight less than 1500 g require additional long term ophthalmic follow up?. British journal of ophthalmology. 2006 Apr 1;90(4):451-5.

79. Mazarei M, Fard MA, Merat H, Roohipoor R. Associations of refractive amblyopia in a population of Iranian children. Journal of Optometry. 2013 Jul 1;6(3):167-72.

80. Multi-ethnic Pediatric Eye Disease Study Group. Prevalence of amblyopia and strabismus in African American and Hispanic children ages 6 to 72 months: the Multi-ethnic Pediatric Eye Disease Study. Ophthalmology. 2008 Jul 1;115(7):1229-36.

81. Menon V, Chaudhuri Z, Saxena R, Gill K, Sachdev MM. Profile of amblyopia in a hospital referral practice. Indian journal of ophthalmology. 2005 Oct 1;53(4):227-34.

82. Pan CW, Qian DJ, Zhu H, Yu JJ, Liu H. Apgar score and reduced vision in children aged 3 to 6 years. Graefe's Archive for Clinical and Experimental Ophthalmology. 2017 Feb;255(2):401-5.

ANNEXURES

ANNEXURE I

अखिल भारतीय आयुर्विज्ञान संस्थान, जोधपुर
All India Institute of Medical Sciences, Jodhpur
संस्थागत नैतिकता समिति
Institutional Ethics Committee

No. AIIMS/IEC/2021/3526 Date: 12/03/2021

ETHICAL CLEARANCE CERTIFICATE

Certificate Reference Number: **AIIMS/IEC/2021/3361**

Project title: **"A study of prevalence and risk factors of amblyopia in school going children belonging to 3-12 years age group"**

Nature of Project:	**Research Project Submitted for Expedited Review**
Submitted as:	**M.D. Dissertation**
Student Name:	**Dr. Falguni Roy**
Guide:	**Dr. Kavita R Bhatnagar**
Co-Guide:	**Dr. Kuldeep Singh, Dr. Pankaja Ravi Raghav & Dr. Pankaj Bhardwaj**

Institutional Ethics Committee after thorough consideration accorded its approval on above project.

The investigator may therefore commence the research from the date of this certificate, using the reference number indicated above.

Please note that the AIIMS IEC must be informed immediately of:

- Any material change in the conditions or undertakings mentioned in the document.
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research.

The Principal Investigator must report to the AIIMS IEC in the prescribed format, where applicable, bi-annually, and at the end of the project, in respect of ethical compliance.

AIIMS IEC retains the right to withdraw or amend this if:

- Any unethical principle or practices are revealed or suspected
- Relevant information has been withheld or misrepresented

AIIMS IEC shall have an access to any information or data at any time during the course or after completion of the project.

Please Note that this approval will be rectified whenever it is possible to hold a meeting in person of the Institutional Ethics Committee. It is possible that the PI may be asked to give more clarifications or the Institutional Ethics Committee may withhold the project. The Institutional Ethics Committee is adopting this procedure due to COVID-19 (Corona Virus) situation.

If the Institutional Ethics Committee does not get back to you, this means your project has been cleared by the IEC.

On behalf of Ethics Committee, I wish you success in your research.

Dr. Pravesh Sharma
Member Secretary

ANNEXURE II

PROFORMA

Date:

Name:

Age:

Registration Number:

Address:

Contact Number:

Informed Written Consent Form Obtained:

Educational Level:

Socio Economic Status:

Family History of Amblyopia:

Antenatal History of Mother:

1. Age of Conception:
2. Weight at Conception:
3. Height:
4. History of Substance Abuse:

History of Working in Toxic Environment:

Birth History:

1. Gestational Age at Birth:
2. Weight at Birth (Gm):
3. Height at Birth (Cm):
4. Type of Delivery

Post Natal Complications:

Ocular Pathology at Birth:

Immunization History:

OCULAR EXAMINATION:

S.NO		RIGHT EYE	LEFT EYE
1	Visual Acuity (Unaided) Distance		
2	Visual Acuity (Best Corrected)		
3	Intra Ocular Pressure (I-Care)		
4	Contrast Sensitivity		
5	Stereoacuity Test:		
6	Binocular Alignment • Corneal Light Reflex • Cover /Uncover Test		
7	Ocular Motility		
8	Lids and Adnexa		

ANTERIOR SEGMENT EVALUATION:

RIGHT EYE	LEFT EYE

CYCLOPLEGIC REFRACTION:

RIGHT EYE	LEFT EYE

FUNDUS EXAMINATION:

RIGHT EYE	LEFT EYE

REFERRAL TO OTHER DEPARTMENT:

CAUSE OF REFERRAL	DEPARTMENT REFERRED TO

ANNEXURE III

All India Institute of Medical Sciences
Jodhpur, Rajasthan

Informed Consent Form

Title of Thesis/Dissertation: A study of prevalence and risk factors of amblyopia in school going children of age group 3-12 years

Name of PG Student: Dr.Falguni Roy Tel. No. 9883092378/_____

Patient/Volunteer Identification No._____

I,_____F/o or M/o or Principal or Class Teacher_____R/o_____

give my full, free, voluntary consent for my child‟s to be a part of the study "A study prevalence and risk factors of amblyopia in school going children belonging to age group of 3-15 years ", the procedure and nature of which has been explained to me in my own language to my full satisfaction. I confirm that I have had the opportunity to ask questions.

I understand that my participation is voluntary and am aware of my child‟s right to opt out of the study at any time without giving any reason.

I understand that the information collected about my child and any of my child‟s medical records may be looked at by responsible individual from Department of Ophthalmology, ALL INDIA INSTITUTE OF MEDICAL SCIENCES (AIIMS) or from regulatory authorities. I give permission for these individuals to have access to my records.

_____

Signature/Left thumb impression of F/o, M/o, Principal, Class teacher

This to certify that the above consent has been obtained in my presence.

Date:_____ Place: _____

Signature of PG Student

Witness 1	Witness 2
Signature	Signature
Name:_____	Name:_____
Address:_____	Address:_____
Phone no_____	Phone no_____

ANNEXURE IV

सूचित सहमचत प्रपत्र थीचसस /
चिबंध का शीर्क :

स्कूल जाने वाले बच्चों मेंं एम्बीलोपियिा की व्याप्तिकतिा और जोपखम वाले कारकोंं का अेध्ययन **3-12** वषष अयु वग के बच्चों मेंं करना।

पीजी छात्रा का नाम: डॉ. फालगुनी रॉय । दूरभाष संख्या : 9883092378

रोगी / स्वयंसेवी की पहचान._____मैं,

_____पपता या माता या अपभभावक_____

मेरे बच्चे को अध्ययन का पहस्सा बनने के पलए अपनी पूर्, स्वतंत्र, स्वैच्छिक सहमपत व्यक्त करती / करता हूँ। थीपसस / पनबंध का शीषक "स्कूल जाने वाले बच्चों मेंं एम्बीलोपियिा की व्याप्तिकतिा और जोपखम वाले कारकोंं का अेध्ययन **3-12** वषष अयु वग के बच्चों मेंं करना।"

पजस प्रपियिा और प्रकृ पत को मुझे अपनी पूरी संतुप्ति के पलए अपनी भाषा मेंं समझाया गया है मैंं पुपि करती / करता हं पक मुझे प्रश्न पूछने का अवसर पमला है। मैंं समझती / समझता हं पक मेरी भागीदारी स्वैच्छिक है और मेरे बच्चे को पकसी भी कारर् पदए पबना पकसी भी समय अध्ययन से बाहर पनकलने के अपधकार की जानकारी है। मैं समझती / समझता हं पक मेरे बच्चे और मेरे बच्चे के मेपडकल ररकॉड के बारे मेंं एकपत्रत की गई जानकारी को नेत्र पवज्ञान पवभाग, अच्छिल भारतीय पचपकत्सा पवज्ञान संस्थान से पजम्मेदार व्यक्ति द्वारा देिा जा सकता है। मैंं इन व्यक्तियोंं को अपने अपभलेिोंं तक पहंच के पलए अनुमपत देती / देता हं।

पपता या माता या अपभभावक के हस्ताक्षर / बाएं अंगूठे का छाप

यह प्रमापर्त करने के पलए पक मेरी उपप्तस्थपत मेंं उपरोक्त सहमपत प्राप्त की गई है।

तारीि :_____स्थान:_____पीजी छात्रा के हस्ताक्षर_____

1. गवाह 1
हस्ताक्षर :
नाम: _____
पता :_____

2. गवाह 2
हस्ताक्षर:
नाम: _____
पता : _____

ANNEXURE V

STUDY PARTICIPANT INFORMATION SHEET

Title of Thesis/Dissertation: A study of prevalence and risk factors of amblyopia in school going children belonging to age group 3-12 years of age.

You are invited to take part in this research study. Before you decide whether or not to take part it is important for you to understand why the research is being done and what will it involve. Please take your time to read the information and then decide. Queries if any will be addressed. This study aims is to screen and study the prevalence and risk factors of amblyopia in school going children belonging to age group of 3-12 years.

1) Why have I been chosen to take part in the study?

You have been chosen to take part in the study because you have Amblyopia. Amblyopia is a unilateral or, less commonly, bilateral reduction of best-corrected visual acuity that occurs in the setting of an otherwise normal eye, or a structural abnormality involving the eye or visual pathway, with reduction in visual acuity that cannot be attributed only to the effect of the structural abnormality. Symptoms of amblyopia include unilateral diminution of vision, decreased contrast sensitivity, decreased depth of vision. Conventional treatment of amblyopia is by Occlusion of better eye but binocular video games for amblyopia is emerging as newer treatment modality.

2) What is the purpose of the study?

The purpose of the study is to screen and find out ocular and non-ocular risk factors of amblyopia and its prevalence in the society. Since most of the risk factors are modifiable ,a health education program to provide relevant information to reproductive women can prevent such condition .Since amblyopia is an reversible condition when diagnosed early , early screening helps in early treatment which prevents lifelong ocular morbidity.

3) Do I have to take part in the study?

It is up-to you to decide whether or not to take part. In case you decide to take part, you will be given the information sheet and will be asked to sign the consent form. If you decide to take part you can still withdraw your consent anytime in the study without giving any reasons.

4) What will happen to me if I take part in the research?

This study is a cross sectional study which means that it is a onetime screening. You will be subjected to a history taking and examination. The examinations include visual acuity, best corrected visual acuity, stereoacuity testing, Binocular alignment and ocular motility, External examination, Anterior segment examination, Cycloplegic retinoscopy/refraction, Funduscopic examination.

5) What do I have to do?

Most of the tests done in the study are a part of routine evaluation. Parents/Principal/Class Teacher will have to give consent for the study and read the patient information sheet provided to them. You will have to cooperate for visual acuity, best corrected visual acuity, stereoacuity testing, binocular alignment and ocular motility, external examination, anterior segment examination, cycloplegic retinoscopy/refraction, funduscopic examination.

6) What are the possible side effects of taking part in the study?

There are no additional side effects of taking part in the study.

7) What are the possible benefits of taking part in the study?

Amblyopia if untreated the vision in the affected eye will be permanently decreased causing deficits in depth perception and peripheral vision. Since there is consensus that earlier screening is important for both prevention and treatment of amblyopia. The earlier that clinically significant refractive error and strabismus are treated, the greater the likelihood of preventing amblyopia.

8) Will my data be kept confidential?

Your child‟s medical records and demographic data will be disclosed only to the researcher, treating physician and concerned authorities.

ANNEXURE VI

रोगी सूचिका पत्रक

थीचसस / चिबंध का शीर्क- स्कूल जाने वाले बच्चों मेंं एम्बीलोपियाकी व्याकितता और जोपखम वाले कारकोंं का अेध्ययन **3-12** वषष अयु वग के बच्चों मेंं करना।

आपको इस शोध अध्ययन मेंं भाग लेने के पलए आमंपत्रत पकया जाता है।भाग लेना है या नहीं, यह तय करने से पहले यह आपके पलए समझना महत्वपूर्् है पक शोध क्योंं पकया जा रहा है और इसमें क्या शापमल होगा। कृपया जानकारी पढ़ने और पफर तय करने केपलए अपना समय लेंं। अिके हर प्रश्न को संबोपधत पकया जाएगा। इस अध्ययन का उद्देश्य " स्कूल जाने वाले बच्चों मेंं एम्बीलोपिया की व्याकितता और जोपखम वाले कारकोंं का अेध्ययन 3-12 वष अयु वग के बच्चेमेंं करना है ।

1) अध्ययन में भाग लेने के पलए मुझे क्योंं चुना गया है?

1) अिको अेध्ययन मेंं भाग लेने के पलए चुना गया है क्योंकक अिके िास एपम्बलोपिया है एम्बीलोपिया एक एकतरफा या, कम सामान्यतः, सबसे सही-सही दृश्य तीक्ष्णता की पिक्षीय कमी है जो अेन्यथा सामान्य अंख की स्थाना मेंं होती है, या एक संरचनात्मक अेसामान्यता पजसमेंं अंख या दृश्य मागष शापमल है, दृश्य तीक्ष्णता मेंं कमी के साथ केवल

आसके पलए पजम्मेदार नहीं ठहराया जा सकता ह। संरचनात्मक अेसामान्यता का प्रभाव।

एम्बोलोपिया के लक्षणोंं मेंं दपि की एकतरफा कमी, पवरीत संवेदनशीलता मेंं कमी, क्षय शापमल हैं ।

2) अध्ययन का उद्देश्य क्या है?

2) अेध्ययन का ईद्दश्य स्रीननग और समाज मेंं अेस्ितिा और आसके प्रसार के ओकु लर और गैर-

ओकु लर जोपखम वाले कारकोंं का ितिा लगानिा ह। समाज के अेपधकांश जोपखम वाले कारकोंं को

संशोपधत ककयिा जा सकतिा है, प्रजनन मपहलाओं को प्रासंपगक जानकारी प्रदान करने के पलए एक

हीथ पशक्षिा कायषरम ऐसी पस्थपत को रोक सकतिा ह। चूंकक एम्बोलोपियिा एक प्रपतवती पस्थपत है

जब प्रारंपभक पनदान ककयिा जातिा है, प्रारंपभक जांच प्रारंपभक ईिचार

मेंं मदद करती है जो अजीवन नेत्रहीन रुग्णता को रोकता ह।ै

3) क्या मुझे अध्ययन में भाग लेना जरूरी है?

3) अिकी एक रोगी सूचना ित्र कदया जाएगा और अिकी अिनी भाषा में अध्ययन की प्रकरया और प्रकृपत के बारे में समझाया जाएगा। अध्ययन में भाग लेना है या नहीं, यह अिको तय करना ह। यकद अि भाग लेने का पनणय लेते तो अिसे अिेक्षा की जाती है,ं

है कक अि रोगी सूचना ित्र को अेच्छी तरह से िढ़ने के बाद सहमपत ित्र िर हस्ताक्षर करेंगे। यकद अि प्रकरयाओं के साथ सहज नहीं है,ं तो अि कोइ कारण बताए पबना,

ककसी भी समय, अध्ययन से अिनी भागीदारी वाि स ले सकते हैं।

4) यपद मैं अध्ययन में भाग लेती / लेता हं तो मेरे साथ क्या होगा?

4)यह अध्ययन एक पवश्लेषर्ात्मक िॉस-अनुभागीय अध्ययन है और एक बार की स्क्रीपनंग है। आप एक इपतहास लेने और परीक्षा के अधीन होगे। परीक्षाओं में दृश्य तीक्ष्र्ता, सवोत्तम सही दृश्य तीक्ष्र्ता, स्टीररयोपसटी परीक्षर्, पृ्वनेत्री संरेि्र और ओकु लर गपतशीलता, बाहरी परीक्षा, पूवकाल िंड परीक्षा, साइक्लोपेपलक रेपटनोस्कोपी / अपवतन, फं डेस्कोपपक परीक्षा शापमल हैं।

5) मुझे क्या करना होगा?

5) अध्ययन में पकए गए अपधकांश परीक्षर् पनयपमत मूल्ांकन का एक पहस्सा हैं। माता-पपता / अपभभावक को अध्ययन के पलए सहमपत देनी होगी और उन्हें प्रदान की गई रोगी सूचना पत्र को पढ़ना होगा। आपको दृश्य तीक्ष्र्ता के पलए सहयोग करना होगा, सबसे अिी तरह से सही दृश्य तीक्ष्र्ता, स्टीररयोपसटी परीक्षर्, पृ्वनेत्री संरेि्र और महासागरीय गपतशीलता, बाहरी परीक्षा, पूवकाल िंड परीक्षा, साइक्लोप्लेपजक रेपटनोस्कोपी

/ अपवतन, फं डस्कॉपपक परीक्षा। यह एक f ॉस सेक्शनल अध्ययन है, इसपलए आपकी ओर से कोई अनुवती कारवाई नहीं की जाती है।

6) अध्ययन में भाग लेने के संभापवत दुष्प्रभाव क्ा हैं?

6)अध्ययन मेंं भाग लेनेे केे कोई भी दुष्प्रभाव
नहीं हैं।

7) अध्ययन में भाग लेने के संभापवत लाभ क्ा हैं?

7) यपद एम्बीलोपपया प्रभापवत आंि मेंं अनुपचाररत पकया गया तो प्रभापवत आंि मेंं स्थायी

रूप से दपि कम हो जाएगी पजससे गहराई की धारर्ा और पररधीय दपि में कमी हो सकती है। चूूँपक इस बात पर आम सहमपत है पक पहले की स्क्रीपनंग, एच्छम्बयोपपया की रोकथाम और उपचार दोनोंं केे पलए महत्वपूर्ण हैै। पहलेे पक नैदापनक रूप सेे महत्वपूर्ण अपवतक त्रुपट और स्टैपबस्मस का इलाज पकया जाता हैै, पररवेशी रूप सेे रोकनेे की संभावना अपधक होती हैै।

8) क्ा मेरा डेटा गोपनीय रिा जाएगा?

8) आपकेे बच्चेे केे मेपडकल ररकॉड और जनसांख्यकीय डेटा का केे वल शोधकता, पचपकत्सक और संबंपधत अपधकाररयोंं केे सामनेे िुलासा पकया जाएगा।

ANNEXURE VII
MASTER CHART