INTRODUCTION

The human eye is the organ which gives us the sense of sight, allowing us to learn more about the surrounding world than we do with any of the other four senses. We use our eyes in almost every activity we perform, whether reading, working, watching television, writing a letter, driving a car, and in countless other ways. Most people probably would agree that sight is the sense they value more than all the rest. The eye allows us to see and interpret the shapes, colors, and dimensions of objects in the world by processing the light they reflect or emit. The eye is able to see in bright light or in dim light, but it cannot see an object when light is absent.

The importance of the optic nerve to vision has long been known. It is the essential link between eye and brain that makes vision possible. If the optic nerve is seriously affected by disease or damaged through trauma or a tumor, visual loss or blindness may result.

Myopia is the medical term for nearsightedness. People with myopia see objects more clearly when they are close to the eye, while distant objects appear blurred or fuzzy. Reading and close-up work may be clear, but distance vision is blurry.

Myopia is a leading cause of loss of vision throughout the world, and its prevalence is increasing. The World Health Organization has grouped myopia and uncorrected refractive error with cataract, macular degeneration, infectious disease, and vitamin A deficiency among the leading causes of blindness and vision impairment in the world [87]. The global prevalence of refractive errors has been estimated from 800 million to 2.3 billion [46]. Myopia is reaching epidemic proportions, especially in Asia, due to urbanization and increased screen and text-based activity throughout all aspects of our daily lives. The number of myopes in the world is estimated to grow from 1.6 billion now to a staggering 2.5 billion by 2020 [3]. Uncorrected myopia affects learning and development, and high myopia creates a significant risk of retinal malfunction leading to vision loss. If left undetected and uncorrected, myopia can adversely affect a child’s education and learning ability. Myopia also doubles the risk of serious eye problems such as glaucoma or retinal detachment, which can cause permanent vision loss, even blindness. Visual impairment due to uncorrected refractive error (<6/18 in adults and <6/12 in children) has been estimated to affect as many as 200 to 250 million people worldwide [89].

The incidence of myopia within sampled population often varies with age, country, sex, race, ethnicity, occupation, environment, and other factors. Although most researchers agree that people's refractive status is in large part genetically determined, a growing body of evidence shows that visual experiences early in life may affect ocular growth and eventual refractive status.

The prevalence of myopia varies by country and by ethnic group, reaching as high as 70-90% in some Asian populations [87]. In India, the prevalence of myopia in the general population has been reported to be 6.9% [55][56]. A recent review found that 26.6% of Western Europeans aged 40 or over have at least −1.00 diopters of myopia and 4.6% have at least −5.00 diopters [57].
**Definition:** Myopia (from Greek: μυωπία myopia "near-sightedness"), also called near- or short-sightedness, is a refractive defect of the eye in which collimated light produces image focus in front of the retina when accommodation is relaxed.

In myopia, the image is focused in front of the retina because the cornea or lens curvature is too strong or the eye is too long (axial myopia). Those with myopia see nearby objects clearly but distant objects appear blurred. With myopia, the eyeball is too long, or the cornea is too steep, so images are focused in the vitreous inside the eye rather than on the retina at the back of the eye. The opposite defect of myopia is hyperopia or "farsightedness" or "long-sightedness" - this is where the cornea is too flat or the eye is too short.

**Description:** To understand myopia it is necessary to have a basic knowledge of the main parts of the eye's focusing system: the cornea, the lens, and the retina.

**Cornea:** The cornea is the tough, transparent, dome-shaped window covering the front of the eye (not to be confused with the white, opaque sclera). The cornea lies in front of the iris (the colored part of the eye).

It is a powerful refracting surface, providing 2/3 of the eye's focusing power. Like the crystal on a watch, it gives us a clear window to look through.

Because there are no blood vessels in the cornea, it is normally clear and has a shiny surface. The cornea is extremely sensitive - there are more nerve endings in the cornea than anywhere else in the body. The adult cornea is only about 1/2 millimeter thick and is comprised of 5 layers: epithelium, Bowman's membrane, stroma, Descemet's membrane and the endothelium.
The layers of the cornea: The epithelium is a layer of cells that cover the surface of the cornea. It is only about 5-6 cell layers thick and quickly regenerates when the cornea is injured. If the injury penetrates more deeply into the cornea, it may leave a scar. Scars leave opaque areas, causing the cornea to lose its clarity and luster.

Bowman's membrane lies just beneath the epithelium. Because this layer is very tough and difficult to penetrate, it protects the cornea from injury.

The stroma is the thickest layer and lies just beneath Bowman's. It is composed of tiny collagen fibrils that run parallel to each other. This special formation of the collagen fibrils gives the cornea its clarity.

Descemet's membrane lies between the stroma and the endothelium.

The endothelium is just underneath Descemet's and is only one cell layer thick. This layer pumps water from the cornea, keeping it clear. If damaged or disease, these cells will not regenerate. Tiny vessels at the outermost edge of the cornea provide nourishment, along with the aqueous and tear film.

Lens: The crystalline lens is a transparent, double-convex structure located just behind the iris. Its purpose is to focus light onto the retina. The nucleus, the innermost part of the lens, is surrounded by softer material called the cortex. The lens is encased in a capsular-like bag and suspended within the eye by tiny "guy wires" called zonules.

In young people, the lens changes shape to adjust for close or distance vision. This is called accommodation. With age, the lens gradually hardens, diminishing the ability to accommodate.

Retina: The retina is a thin membrane that lines the rear of the eyeball. It is a multilayered sensory tissue, a multilayered membrane measuring from 0.10 to 0.23 mm thick that lines the back of the eye. It contains millions of photoreceptors that capture light rays and convert them into electrical impulses. These impulses travel along the optic nerve to the brain where they are turned into images. The retina is nourished by the retinal blood vessels and the choroidal blood vessels.
There are two types of photoreceptors in the retina: rods and cones. The retina contains approximately 6 million cones. The cones are contained in the macula, the portion of the retina responsible for central vision. They are most densely packed within the fovea, the very center portion of the macula. Cones function best in bright light and allow us to appreciate color.

There are approximately 125 million rods. They are spread throughout the peripheral retina and function best in dim lighting. The rods are responsible for peripheral and night vision.

This photograph shows a normal retina with blood vessels that branch from the optic nerve, cascading toward the macula.

**Macula:** The macula is located roughly in the center of the retina, temporal to the optic nerve. It is a small and highly sensitive part of the retina responsible for detailed central vision. The fovea is the very center of the macula. The macula allows us to appreciate detail and perform tasks that require central vision such as reading.

The visual axis of the eye intersects the retina at the fovea, the center of the macula. The fovea is centered between the temporal vascular arcades and can be identified as a circular pigmented area slightly larger than the disc.

*Introduction*
Light-sensitive retinal cells convert incoming light rays into electrical signals that are sent along the optic nerve to the brain, which then interprets the images.

**Optic nerve:** The optic nerve transmits electrical impulses from the retina to the brain. It connects to the back of the eye near the macula. When examining the back of the eye, a portion of the optic nerve called the optic disc can be seen. The beginning of the optic nerve in the retina is called the optic nerve head or optic disk. Since there are no photoreceptors (cones and rods) in the optic nerve head, this area of the retina cannot respond to light stimulation. As a result, it is known as the "blind spot," and everybody has one in each eye.

**Process of vision:** Light waves from an object (such as a tree) enter the eye first through the cornea, which is the clear dome at the front of the eye. The light then progresses through the pupil, the circular opening in the center of the colored iris. Next, the light passes through the crystalline lens, which is located immediately behind the iris and the pupil.

Initially, the light waves are bent or converged first by the cornea, and then further by the crystalline lens, to a nodal point (N) located immediately behind the back surface of the lens. At that point, the image becomes reversed (turned backwards) and inverted (turned upside-down).
The light continues through the vitreous humor, the clear gel that makes up about 80% of the eye's volume, and then, ideally, back to a clear focus on the retina behind the vitreous. The small central area of the retina is the macula, which provides the best vision of any location in the retina. If the eye is considered to be a type of camera, the retina is equivalent to the film inside of the camera, registering the tiny photons of light which interact with it.

Within the layers of the retina, light impulses are changed into electrical signals and then sent through the optic nerve, along the visual pathway, to the occipital cortex at the posterior or back of the brain. Here, the electrical signals are interpreted or "seen" by the brain as a visual image. Actually, then, we do not "see" with our eyes but, rather, with our brains. Our eyes merely are the beginnings of the visual process. When the light entering the eyes is bright enough, the pupils will constrict (get smaller), due to the pupillary light response.

**Anatomy of Optic Nerve:** The optic nerve is the second of twelve paired cranial nerves but is considered to be part of the central nervous system as it is derived from an outpouching of the diencephalon during embryonic development. Consequently, the fibers are covered with myelin produced by oligodendrocytes rather than the Schwann cells of the peripheral nervous system. Similarly, the optic nerve is ensheathed in all three meningeal layers (dura, arachnoid, and pia mater) rather than the epineurium, perineurium, and endoneurium found in peripheral nerves. This is an important issue, as fiber tracks of the mammalian central nervous system (as opposed to the peripheral nervous system) are incapable of regeneration and hence optic nerve damage produces irreversible blindness. The fibers from the retina run along the optic nerve to nine primary visual nuclei in the brain, from whence a major relay inputs into the primary visual cortex.

Its diameter increases from about 1.6 mm within the eye, to 3.5 mm in the orbit to 4.5 mm within the cranial space. The optic nerve component lengths are 1 mm in the globe, 25 mm in the orbit, 9 mm in the optic canal and 16 mm in the cranial space before joining the optic chiasm. There, partial decussation occurs and about 53% of
the fibers cross to form the optic tracts. Most of these fibers terminate in the lateral geniculate body.

The optic nerve, which acts like a cable connecting the eye with the brain, actually is more like brain tissue than it is nerve tissue.

**Visual pathway:** The optic nerve is composed of retinal ganglion cell axons and support cells. It leaves the orbit (eye) via the optic canal, running postero-medially towards the optic chiasm where there is a partial decussation (crossing) of fibers from the temporal visual fields of both eyes, i.e. optic nerve fibers emanating from the nasal half of each retina cross over to the other side; but the nerve fibers originating in the temporal retina do not cross over.
As the optic nerve leaves the back of the eye, it travels to the optic chiasm, located just below and in front of the pituitary gland (which is why a tumor on the pituitary gland, pressing on the optic chiasm, can cause vision problems).

From there, the nerve fibers become the optic tract, passing through the thalamus and turning into the optic radiation. Most of the axons of the optic nerve terminate in the lateral geniculate nucleus. From the lateral geniculate body, fibers of the optic radiation pass to the visual cortex in the occipital lobe at the back of the brain. This is where the visual center of the brain is located. Information is relayed to the visual cortex. The visual cortex ultimately interprets the electrical signals produced by light stimulation of the retina, via the optic nerve, as visual images. More specifically, fibers carrying information from the contralateral superior visual field traverse Meyer's loop to terminate in the lingual gyrus below the calcarine fissure in the occipital lobe, and fibers carrying information from the contralateral inferior visual field terminate more superiorly.

**Physiology of Optic Nerve:** The optic nerve (also known as cranial nerve II) is a continuation of the axons of the ganglion cells in the retina, contains 1.2 million nerve fibers. This number is low compared to the roughly 130 million receptors in the retina, and implies that substantial pre-processing takes place in the retina before the signals are sent to the brain through the optic nerve.

The eye's blind spot is a result of the absence of retina where the optic nerve leaves the eye. This is because there are no photoreceptors (sensory receptor cells of retina) in this area. Because of this, everyone has a normal blind spot. This is not normally noticeable because the vision of both eyes overlaps.

In people with **normal vision**, parallel light rays enter the eye and are bent by the cornea and lens (a process called refraction) to focus precisely on the retina, providing a crisp, clear image. In the **myopic eye**, the focusing power of the cornea (the major refracting structure of the eye) and the lens is too great with respect to the length of the eyeball. Light rays are bent too much, and they converge in front of the retina.
This inaccuracy is called a refractive error. In other words, an over focused fuzzy image is sent to the brain.

Classification Of Myopia: Myopia has been classified in various manners \(^{14}\)\(^{15}\)\(^{16}\)

**By Etiology:** Borish and Duke-Elder classified myopia by cause \(^{15}\)\(^{16}\)

- **Axial myopia** is attributed to an increase in the eye's axial length.\(^{17}\)
- **Refractive myopia** is attributed to the condition of the refractive elements of the eye.\(^{17}\) Borish further subclassified refractive myopia: \(^{15}\)
  - **Curvature myopia** is attributed to excessive, or increased, curvature of one or more of the refractive surfaces of the eye, especially the cornea.\(^{17}\) In those with Cohen syndrome, myopia appears to result from high corneal and lenticular power.\(^{16}\)
  - **Index myopia** is attributed to variation in the index of refraction of one or more of the ocular media.\(^{17}\)

**By Clinical entity:** Various forms of myopia have been described by their clinical appearance: \(^{16}\)\(^{19}\)

- **Simple myopia** is more common than other types of myopia and is characterized by an eye that is too long for its optical power (which is determined by the cornea and crystalline lens) or optically too powerful for its axial length.\(^{20}\) Both genetic and environmental factors, particularly significant amounts of near work, are thought to contribute to the development of simple myopia.\(^{20}\)
- **Degenerative myopia**, also known as malignant, pathological, or progressive myopia, is characterized by marked fundus changes, such as posterior staphyloma, and associated with a high refractive error and subnormal visual acuity after correction.\(^{17}\) This form of myopia gets progressively worse over time. Degenerative myopia has been reported as one of the main causes of visual impairment.\(^{21}\) Myopia with degenerative changes has been described as being very common in certain races and cultures, such as Chinese, Japanese, Arab, and Jewish people.\(^{22}\)
- **Nocturnal myopia**, also known as night myopia or twilight myopia, is a condition in which the eye has a greater difficulty seeing in low illumination areas, even though its daytime vision is normal. Essentially, the eye's far point of an individual's focus varies with the level of light. Night myopia is believed to be caused by pupils dilating to let more light in, which adds aberrations.
resulting in becoming more nearsighted. A stronger prescription for myopic night drivers is often needed. Younger people are more likely to be affected by night myopia than the elderly.\textsuperscript{[23]}

- **Pseudomyopia** is the blurring of distance vision brought about by spasm of the ciliary muscle.\textsuperscript{[24]}

- **Induced myopia**, also known as *acquired myopia*, results from exposure to various pharmaceuticals, increases in glucose levels, nuclear sclerosis, or other anomalous conditions.\textsuperscript{[20]} The encircling bands used in the repair of retinal detachments may induce myopia by increasing the axial length of the eye.\textsuperscript{[25]}
  - **Index myopia** is attributed to variation in the index of refraction of one or more of the ocular media.\textsuperscript{[17]} Cataracts may lead to index myopia.\textsuperscript{[26]}
  - **Form deprivation myopia** is a type of myopia that occurs when the eye is deprived of clear form vision.\textsuperscript{[27]} Myopia is often induced this way in various animal models to study the pathogenesis and mechanism of myopia development.\textsuperscript{[27]}

**By Degree:** Myopia, which is measured in diopters by the strength or optical power of a corrective lens that focuses distant images on the retina, has also been classified by degree or severity.\textsuperscript{[14]}

- **Low myopia** usually describes myopia of −3.00 diopters or less.\textsuperscript{[17]}

- **Medium myopia** usually describes myopia between −3.00 and −6.00 diopters.\textsuperscript{[17]} Those with moderate amounts of myopia are more likely to have pigment dispersion syndrome or pigmentary glaucoma.\textsuperscript{[28]}

- **High myopia** usually describes myopia of −6.00 or more.\textsuperscript{[17]} People with high myopia are more likely to have retinal detachments\textsuperscript{[29]} and primary open angle glaucoma.\textsuperscript{[30]} They are also more likely to experience floaters, shadow-like shapes which appear singly or in clusters in the field of vision. Roughly 30% of myopes have high myopia.\textsuperscript{[22]}

**By Age of Onset:** Myopia is sometimes classified by the age of onset: \textsuperscript{[14]}

- **Congenital myopia**, also known as *infantile myopia*, is present at birth and persists through infancy.\textsuperscript{[20]}

- **Youth onset myopia** occurs prior to age 20.\textsuperscript{[20]}
  - **School myopia** appears during childhood, particularly the school-age years.\textsuperscript{[31]} This form of myopia is attributed to the use of the eyes for close work during the school years.\textsuperscript{[17]}

- **Adult onset myopia**
  - **Early adult onset myopia** occurs between ages 20 and 40.\textsuperscript{[20]}
  - **Late adult onset myopia** occurs after age 40.\textsuperscript{[20]}
Handbook of ocular disease management has described two types of myopia:

**Physiological** myopia is the most common eye disorder worldwide. A <6.00D optical aberration brought about by either increased ocular power (cornea and lens) or increased axial length is considered a normal biologic variation.

**Pathological** myopia (> 6.00D optical aberration) involves structural alterations to the globe, which may threaten sight and ocular health. The pathogenesis of pathological myopia remains unclear. Previous reports have identified a locus for autosomal dominant pathologic myopia to gene 18p11.31. More recent findings posit the genetic heterogeneity of myopia by establishing linkage to a second locus at the 12q2123 regions.

Pathological myopia has two stages, developmental and degenerative. Damage in the developmental stage results from axial lengthening, followed by damage from vascular alterations. Elongation of the globe, known as posterior staphyloma, occurs in stages and results from scleral thinning. Breaks in Bruch's membrane with accompanying choroidal atrophy create lesions known as lacquer cracks. These dehiscences are associated with increased risk for choroidal neovascularization.

In Pathological myopia dilated fundus examination may unveil any of these signs: flat, obliquely inserted discs, posterior staphyloma, a myopic crescent, patchy choroidal atrophy within the posterior pole, breaks in Bruch's membrane with accompanying choroidal atrophy known as lacquer cracks, subretinal neovascular membrane with overlying retinal pigment epithelial hyperplasia (Fuch's spot), subretinal neovascularization without Fuch's spot (subretinal scarring, bleeding, exudate) and retinal breaks or detachments.

People with myopia can be classified in two groups, those with low to modest degrees of myopia (referred to as "simple" or "school" myopia, 0 to -6 dioptres) and those with high or pathological myopia (greater than -6 dioptres). Simple myopia can be corrected with spectacles or contact lenses, whereas "high" (pathological) myopia is often associated with potentially blinding conditions such as retinal detachment, macular degeneration, and glaucoma.

**Epidemiology:** The global prevalence of refractive errors has been estimated from 800 million to 2.3 billion. The incidence of myopia within sampled population often varies with age, country, sex, race, ethnicity, occupation, environment, and other factors. Variability in testing and data collection methods makes comparisons of prevalence and progression difficult.

In India, the prevalence of myopia in the general population has been reported to be only 6.9%. In some areas, such as Japan, Singapore and Taiwan, up to 44% of the adult population is myopic.

A recent study involving first-year undergraduate students in the United Kingdom found that 50% of British whites and 53.4% of British Asians were myopic.
In Australia, the overall prevalence of myopia (worse than −0.50 diopters) has been estimated to be 17%. In one recent study, less than 1 in 10 (8.4%) Australian children between the ages of 4 and 12 were found to have myopia greater than −0.50 diopters. A recent review found that 16.4% of Australians aged 40 or over have at least −1.00 diopters of myopia and 2.5% have at least −5.00 diopters.

In Brazil, a 2005 study estimated that 6.4% of Brazilians between the ages of 12 and 59 had −1.00 diopter or myopia or more, compared with 2.7% of the indigenous people in northwestern Brazil. Another found nearly 1 in 8 (13.3%) of the students in one city were myopic.

In Greece, the prevalence of myopia among 15 to 18 year old students was found to be 36.8%.

A recent review found that 26.6% of Western Europeans aged 40 or over have at least −1.00 diopters of myopia and 4.6% have at least −5.00 diopters.

In the United States, the prevalence of myopia has been estimated at 20%. Nearly 1 in 10 (9.2%) American children between the ages of 5 and 17 have myopia. Approximately 25% of Americans between the ages of 12 and 54 have the condition.

A recent review found that 25.4% of Americans aged 40 or over have at least −1.00 diopters of myopia and 4.5% have at least −5.00 diopters.

A study of Jordanian adults aged 17 to 40 found that over half (53.7%) were myopic.

Ethnicity and Race: The prevalence of myopia has been reported as high as 70-90% in some Asian countries, 30-40% in Europe and the United States, and 10-20% in Africa.

Myopia is less common in Black, Nubians, and Sudanese people. In Americans between the ages of 12 and 54, myopia has been found to affect whites less than blacks. Asians had the highest prevalence (18.5%), followed by Hispanics (13.2%). Whites had the lowest prevalence of myopia (4.4%), which was not significantly different from African Americans (6.6%).

Gender: Lower levels of myopia appear to affect both genders equally however, females are more likely to have higher levels of degenerative changes. In Americans between the ages of 12 and 54, myopia has been found to affect women more than men.

Education, Intelligence, and IQ: A number of studies have shown that the prevalence of myopia increases with level of education and many studies have shown a relationship between myopia and IQ. However, care must be taken in interpreting these results as correlation does not imply causation. Reading has been suggested as a cause of myopia.
According to Arthur Jensen, myopes average 7-8 IQ points higher than non-myopes. The relationship also holds within families and siblings with a higher degree of refraction error average higher IQs than siblings with less refraction error. Jensen believes that this indicates myopia and IQ are pleiotropically related as they are caused or influenced by the same genes. The mechanism that has caused a relationship between myopia and IQ is not yet known with certainty.

Another theory suggests that people with higher IQs spend more time reading, and consequently, as their eyes spend more time focusing on near objects, their eye muscles gradually lose their elasticity and become less able to focus on far objects.

Etiology and Pathogenesis: Because in the most common, "simple" myopia, the eye length is too long, any etiologic explanation must account for such axial elongation. To date, no single theory has been able to satisfactorily explain this elongation.

In the early 1900s, William Bates controversially asserted that myopia, as with all refractive errors, resulted from a particular type of "eyestrain" that was itself a result of "mental strain". He stated that the shape of the eyeball responded instantaneously to the action of the extraocular muscles upon it and that myopia was produced due to contraction of the inferior oblique and superior oblique muscles which lengthened the eye. According to Bates, myopia was associated with a "strain" to see distance objects rather than near work. Bates theories were rejected by mainstream ophthalmologists of his time and remain so today.

In the mid-1900s, mainstream ophthalmologists and optometrists believed myopia to be primarily hereditary; the influence of near work in its development seemed "incidental" and the increased prevalence of the condition with increasing age was viewed as a "statistical curiosity".

Among mainstream researchers and eye care professionals, myopia is now thought to be a combination of genetic and environmental factors. There are currently two basic mechanisms believed to cause myopia: form deprivation (also known as pattern deprivation and optical defocus. Form deprivation occurs when the image quality on the retina is reduced; optical defocus occurs when light focus in front of or behind the retina. Numerous experiments with animals have shown that myopia can be artificially generated by inducing either of these conditions. In animal models wearing negative spectacle lenses, axial myopia has been shown to occur as the eye elongates to compensate for optical defocus. The exact mechanism of this image-controlled elongation of the eye is still unknown. It has been suggested that accommodative lag leads to blur (i.e. optical defocus) which in turn stimulates axial elongation and myopia.

Theories:

- **Combination of genetic and environmental factors** - In China, myopia is more common in those with higher education background and some studies suggest that near work may exacerbate a genetic predisposition to develop myopia. Other studies have shown that near work (reading, computer games) may not be associated with myopic progression, however. A
"genetic susceptibility" to environmental factors has been postulated as one explanation for the varying degrees of myopia among individuals or populations but there exists some difference of opinion as to whether it exists. High heritability simply means that most of the variation in a particular population at a particular time is due to genetic differences. If the environment changes as, for example, it has by the introduction of televisions and computers the incidence of myopia can change as a result, even though heritability remains high. From a slightly different point of view it could be concluded that determined by heritage some people are at a higher risk to develop myopia when exposed to modern environmental conditions with a lot of extensive near work like reading. In other words, it is often not the myopia itself which is inherited, but the reaction to specific environmental conditions and this reaction can be the onset and the progression of myopia.

- **Genetic factors** - The wide variability of the prevalence of myopia in different ethnic groups has been reported as additional evidence supporting the role of genetics in the development of myopia. Measures of the heritability of myopia have yielded figures as high as 89%, and recent research has identified genes that may be responsible: defective versions of the PAX6 gene seem to be associated with myopia in twin studies. Under this theory, the eye is slightly elongated front to back as a result of faults during development, causing images to be focused in front of the retina rather than directly on it. It is usually discovered during the pre-teen years between eight and twelve years of age. It most often worsens gradually as the eye grows during adolescence and then levels off as a person reaches adulthood. Genetic factors can work in various biochemical ways to cause myopia; a weak or degraded connective tissue is a very essential one. Genetic factors include an inherited, increased susceptibility for environmental influences like excessive near work, and the fact that some people do not develop myopia in spite of very adverse conditions is a clear indication that heredity is involved somehow in any case.

- **Environmental factors** - It has been suggested that a genetic susceptibility to myopia does not exist. A high heritability of myopia (as for any other condition) does not mean that environmental factors and lifestyle have no effect on the development of the condition. Some recommend a variety of eye exercises to strengthen the ciliary muscle. Other theories suggest that the eyes become strained by the constant extra work involved in "nearwork" and get stuck in the near position, and eye exercises can help loosen the muscles up thereby freeing it for far vision. These primarily mechanical models appear to be in contrast to research results, which show that the myopic elongation of the eye can be caused by the image quality, with biochemical processes as the actuator. Common to both views is, however, that extensive near work and corresponding accommodation can be essential for the onset and the progression of myopia.

One Austrian study confirmed that the axial length of the eye does mildly increase while reading, but attributed this elongation due to contraction of the ciliary muscle during accommodation (the process by which the eye increases optical power to maintain a clear image focus), not "squeezing" of the extraocular muscles.
Near work and nightlight exposure in childhood have been hypothesized as environmental risk factors for myopia\textsuperscript{[66]}\textsuperscript{[666]}. Although one initial study indicated a strong association between myopia and nightlight exposure,\textsuperscript{[67]} recent research has found none \textsuperscript{[666][68][69][70]}.

- Near work. Near work has been implicated as a contributing factor to myopia in some studies, but refuted in others \textsuperscript{[71]}. One recent study suggested that students exposed to extensive "near work" may be at a higher risk of developing myopia, whereas extended breaks from near work during summer or winter vacations may retard myopic progression \textsuperscript{[14]}. Near work in certain cultures (e.g. Vanuatu) does not result in greater myopia \textsuperscript{[15][16][17][18]}. It has been hypothesized that this outcome may be results of genetics or environmental factors such as diet or over-illumination, changes in which seem to occur in Asian, Vanuatu and Inuit cultures acclamating to intensive early studies \textsuperscript{[19]}.

- Diet and nutrition - One 2002 article suggested that myopia may be caused by over-consumption of bread in childhood, or in general by diets too rich in carbohydrates, which can lead to chronic hyperinsulinemia. Various other components of the diet, however, were made responsible for contributing to myopia as well, as summarized in documentation.

- Stress has been postulated as a factor in the development of myopia.\textsuperscript{[72]}

- A Turkish study found that accommodative convergence rather than accommodation, may be a factor in the onset and progression of myopia in adults \textsuperscript{[73]} (Accommodative convergence is that portion of the range of inward rotation of both eyes (i.e. convergence) that occurs in response to an increase in optical power for focusing by the crystalline lens (i.e. accommodation)).

- A recent Polish study revealed that "with-the-rule astigmatism" may lead to the creation of myopia.\textsuperscript{[74]}

- Many people with myopia are able to read comfortably without eyeglasses. Myopes considering refractive surgery are advised that this may be a disadvantage after the age of 40 when the eyes become presbyopic and lose their ability to accommodate or change focus.

**Diagnosis:** A diagnosis of myopia is typically confirmed during an eye examination by an ophthalmologist or an optometrist. Frequently an autorefractor or retinoscope is used to give an initial objective assessment of the refractive status of each eye, then a phoropter is used to subjectively refine the patient's eyeglass prescription.
Treatment, Management, and Prevention: Eyeglasses, contact lenses, and refractive surgery are the primary options to treat the visual symptoms of those with myopia. Orthokeratology is the practice of using special rigid contact lenses to flatten the cornea to reduce myopia.

Eye-exercises and biofeedback: Practitioners and advocates of alternative therapies often recommend eye exercises and relaxation techniques such as the Bates method. However, the efficacy of these practices is disputed by scientists and eye care practitioners. A 2005 review of scientific papers on the subject concluded that there was "no clear scientific evidence" that eye exercises were effective in treating myopia.

In the eighties and nineties, there was a flurry of interest in biofeedback as a possible treatment for myopia. A 1997 review of this biofeedback research concluded that "controlled studies to validate such methods have been rare and contradictory." It was found in one study that myopes could improve their visual acuity with biofeedback training, but that this improvement was "instrument-specific" and did not generalize to other measures or situations. In another study an "improvement" in visual acuity was found but this could be a result of subjects learning the task. Finally, in an evaluation of a training system designed to improve acuity, "no significant difference was found between the control and experimental subjects."

Prevention: There is no universally accepted method of preventing myopia. Some clinicians and researchers recommend plus power (convex) lenses in the form of single vision reading lenses or bifocals. A recent Malaysian study reported in New Scientist suggested that under correction of myopia caused more rapid progression of myopia. However, the reliability of this data has been called into question. Many myopia treatment studies suffer from any of a number of design drawbacks: small numbers, lack of adequate control group, failure to mask examiners from knowledge of treatments used, etc. Pirenzepine eye drops had a limited effect on retarding myopic progression in a recent, placebo-control, double-blinded prospective controlled study.
Myopia Control: Various methods have been employed in an attempt to decrease the progression of myopia. Altering the use of eyeglasses between full-time, part-time, and not at all does not appear to alter myopia progression. Bifocal and progressive lenses have not shown significant differences in altering the progression of myopia.

Fundus Photography: Fundus photography is a process using special optical imaging equipment e.g., cameras to photograph structures of the eye. Retinal fundus photography is highly specialized forms of medical imaging dedicated to the study and treatment of ocular disorders.

In Medicine, the term fundus is used to describe the inner lining of a hollow organ. The ocular fundus is the inner lining of the eye made up of the retinal layers and underlying choroid. The retina is the "film" of the eye - capturing images which pass through the clear structures of the cornea and lens. It is the only place in the body where nerve fibres and blood vessels can easily be seen making retinal images invaluable in monitoring the progression of ocular conditions as well as to catalogue ocular health.

Fundus photography involves the use of a retinal camera to photograph the regions of the vitreous, retina, choroid, and optic nerve. Fundus photography is indicated to document abnormalities related to disease processes affecting the eye or to follow the progress of the disease.
Indications: Fundus photography may be indicated to document abnormalities related to a disease process affecting the eye, or to follow the progress of such disease.

In order to document a disease process or follow the progress of a disease, photographs and an interpretation and report of the test may be necessary.

Photographs and an interpretation and report of the test may also be necessary to plan treatment for a disease process.

Photographs of the back of eye are necessary to document the health of the optic nerve, vitreous, macula, retina and its blood vessels. The photographs are used for comparison, documentation, and sometimes to diagnose certain eye conditions.

Because fundus photography is a highly specialized form of medical imaging, it can’t be done with an ordinary camera. It requires a customized camera that is mounted to a microscope with intricate lenses and mirrors. These high-powered lenses are designed so the photographer can visualize the back of the eye by focusing light through the cornea, pupil and lens.

A fundus camera or retinal camera is a specialized low power microscope with an attached camera designed to photograph the interior surface of the eye, including the retina, optic disc, macula, and posterior pole i.e., the fundus. Camera is also attached to the computer so photographs can be stored and possible to preserve all the records. It is also possible to send these records to different places for expert opinion or for their study.

Before beginning, the pupil is dilated with mydriatic eye drops. Otherwise, it would automatically constrict from the bright light of the camera flash. The patient is asked to stare at a fixation device so the eyes are still. While the photographer is taking the pictures, the patient will see a series of bright flashes.

Fundus is the bottom or base of anything. In medicine, it is a general term for the inner lining of a hollow organ. The ocular fundus is the inner lining of the eye made up of the Sensory Retina, the Retinal Pigment Epithelium, Bruch's Membrane, and the Choroid. The Fundus, or inner lining, of the eye is photographed with specially designed cameras through the dilated pupil of the patient. The painless procedure produces a sharp view of the retina, the retinal vasculature, and the optic nerve head (optic disc) from which the retinal vessels enter the eye.
The important fundus landmark in normal fundus photograph is the optic disc. This somewhat oval, pink structure is located about 15 degrees nasal to the central visual axis (fovea). The optic disc measures about 1.5mm in diameter. The optic disc contains more than a million axons which make up the neural rim of the optic disc, which surrounds a central, whitish depression of variable size (the optic cup). The visual axis of the eye intersects the retina at the fovea, the center of the macula. The fovea is centered between the temporal vascular arcades and can be identified as a circular pigmented area slightly larger than the disc, measuring only 500 microns across, which is responsible for our most central reading vision. The vessels form an arc around the macula which produces the central 20 degrees of vision. The fundus photographs also show different choroidal markings and gross chorio-retinal findings.

Color Fundus Photogaphy is used to record the condition of these structures in order to document the presence of disorders and monitor their change over time.

Basically, fundus imaging is indicated when you need to document the appearance of the retina and optic nerve, and monitor changes. It provides technologically advanced imaging for clinical data that may not be otherwise available.

Refractive error depends on corneal curvature, axial length and presence or absence of the fovea. As we have seen that one of the cause of myopia is too long eye (axial myopia). So the primary aim of this study is to find out impact of increased axial length of the eye on the optic nerve entry (head). During the study some other fundus changes were also found in digital photographs. So, with the changes of the optic nerve, findings of the study have also extended to observe other fundus changes such as foveal reflex, macular changes; macular degeneration, macular haemorrhage, macular scar, macular pigmentation, staphyloma, tessellations, different chorio-retinal changes such as gross myopic degeneration, angioid streaks, etc. Many studies have been reported related with the optic nerve and fundus changes in glaucoma [206]. So, the thought of doing this study aroused. Also, certain studies have observed that cataract was associated strongly with high axial myopia [192]. Studies also have reported that there is increased risk of developing glaucoma in high myopia and also marked to high myopia may be a risk factor associated with glaucomatous optic neuropathy [190][191].

So, according to above noted basis, following are the aims of the study:

- To observe the changes in optic nerve head and central fundus through fundus photographs in myopia.
- To make correlations of retinal changes with different power of myopia and with age of myopic person.
- To make Anatomical and clinical correlation through fundus photographs.
- To compare the different changes in myopia with the changes in other diseases eg, glaucoma, maculopathy, ARMD etc.
- To prove advantages of Imaging and archiving in clinical practice.
- To compare and confirm advantages of Imaging over scopy in medical field.
- To compare fundus photography with other methods of retinal examination (eg. FFA-Fundus Fluorescein Angiography, OCT-Ocular Coherence Tomography).

Introduction
• To find out congenital defect of the optic Nerve.
• To find out early detection of different changes that leads to Retinal detachment.
• To see the changes and progress of the changes and disease process.

There are very few references found on this study in Indian population. The present study of fundus changes in myopia is the humble attempt for the first time in Gujarat state, as far as I know.