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Research Article

Exploring the Factors that Affect Myopia Development, and its Management

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Abstract

To identify all the possible factor that cause myopia and find its impact on development of progression of myopia. This prospective study was carried out from January 2024 to December 2024 among general patient age between 18 to 30 at Curesee clinic (Dayanand Colony, Sector 6, Gurugram, Haryana 122001) Gurgaon. We enrolled 362 populations from different areas in Gurgaon. The self-structured questionnaire was included in this study to assess the knowledge, the factors that affect myopia development. All the population underwent a complete ophthalmic examination and best corrected visual acuity measurements were taken with or without glasses, weight is measured with the help of weight machine and height is measured with inch tape.

Out of 362 participants, 51.93% had no refractive error, 25.69% had mild myopia, 17.68% had moderate myopia, and 4.70% had high myopia. Gender did not significantly affect refractive error distribution (P = 0.102). Family history showed a significant association with myopia (P < 0.001), with higher occurrences in those with myopic parents. Diet and living area did not significantly influence refractive errors (P = 0.164 and P = 0.052, respectively). BMI was significantly associated with refractive errors (P < 0.001): normal BMI was linked to no refractive error, high BMI to mild/moderate myopia, and low BMI to moderate/high myopia. Outdoor activity (P = 0.000), indoor activity (P = 0.000), and screen time (P = 0.000) were significantly correlated with different levels of myopia.

This study emphasises the higher prevalence and public health importance of physiological myopia. It concludes that gender has no significant impact on the development of myopia, contradicting previous research. However, having myopic parents is still a strong predictor of the condition. The type of diet has no correlation with refractive errors, but BMI does: normal BMI is associated with no refractive error, high BMI with mild to moderate myopia, and low BMI with moderate to high myopia. Screen time and indoor activity are linked to increased myopia, whereas outdoor activity has a protective effect. The study emphasises the complexities of myopia development, specifically the roles of genetic predisposition, environmental exposure, lifestyle choices, and physical health. This comprehensive approach sheds light on targeted interventions and preventive measures to address the growing prevalence of myopia.

Keywords: *Exploring the Factors; Myopia Development; Myopia Management; Refractive Errors; Physiological Myopia; Congenital Myopia*

Introduction

Myopia is a refractive error in which the parallel rays of light that are coming from infinity are focused in front of the retina. It is also known as short-sightedness. In which a person sees a blurry image from far distance. There are many reasons to rays focus in front of the retina such as axial length elongation, increasing refractive index of a lens, accommodation, cornea surface becoming steep, lens dislocating anterior, etc. Based on that myopia are two types, Physiological myopia, and Pathological myopia.

A correlation failure of the refraction components in a normal eye leads to physiological myopia [1]. Physiological myopia is not associated with any underlying disease or pathological condition. Instead, it is often considered a normal variation in eye anatomy.

Pathological myopia sometimes referred to as degenerative or high myopia is a more severe type of myopia linked to complications and structural alterations in the eye. Excessive axial elongation mainly affecting the posterior pole and ora-equatorial area is the cause of pathologic myopia. Ophthalmoscopic evidence of this process includes the formation of posterior staphylomas and changes to the peripheral fundus.

Although the precise cause of myopia is unknown, a combination of environmental and genetic factors is thought to play a role in its development. Children are more likely to develop myopia if one or both of their parents are nearsighted. This hereditary component is believed to be influenced by genes linked to the structure and function of the eye. Environment factors like excessive near work and limited outdoor activity. Food habit, eye strain, age, ethnicity, and educational pressure also cause myopia.

Research is still being done to investigate the mechanisms underlying the development of myopia, as the interaction of these factors is complicated. Developing treatments for myopia requires an understanding of the mechanisms governing the axial growth of the eye and the risk factors for the progression of myopia.

Prevalence of myopia

Myopia has been a problem for developed nations, particularly those in East Asia. To a lesser extent, other regions of the world have similarly shown this trend. The prevalence of myopia and high myopia worldwide indicates that there are currently 1950 million cases (28.3% of the world's population) and 277 million cases (4.0% of the world's population). By 2050, these numbers are expected to rise to 4758 million cases (49.8% of the world's population) for myopia and 938 million cases (9.8% of the world's population) for high myopia [2].

Numerous studies conducted over the last few decades have provided important new information about the prevalence patterns and the triggers for the development of myopia. The percentage of Americans who suffer from myopia increased from 25% to 44% between 1972 and 2004. This represents a significant increase in the prevalence of the condition [3].

Since most myopia cases can be treated with glasses, contacts, or refractive surgery, the condition is generally regarded as benign. Severe myopia, however, carries a risk of blindness and permanent visual impairment because of pathological alterations in the choroid, retina, and sclera. According to one study, 25% of high myopia will experience pathologic myopia, and 50% of those who have pathological myopia will experience low vision as they age. As a result, the older generation's high myopia and pathological myopia are probably going to rise significantly. According to high myopia global projection for 2050, pathological myopia could rise to more than 200 million in the future.

There is a clear correlation between the prevalence of myopia and community development, with most data indicating that myopia is more common in urban than rural areas. Urbanization and the development of myopia in Asia may be related, but there may be a mediating role played by factors like intense schooling, increased near-work, and decreased outdoor time.

S. No	Author	Country	Prevalence (No of subjects)	Publication Year
1)	Pokharel., *et al*. [4]	Mechi Zone, Nepal	1.2%, N - 5067	2000
2)	Murthy., *et al*. [5]	New Delhi, India	7.4%, N - 6447	2002
3)	Dandona., *et al*. [6]	Andhra Pradesh, India.	4.1%, N - 4074	2002
4)	Midelfart., *et al*. [7]	Norway	35%, N - 3137	2002
5)	Raju., *et al*. [8]	India	31%, N-2508	2004
6)	Bourne., *et al*. [9]	Bangladesh	23.8%, N-11189	2004
7)	Tarczy-Hornoch., *et al*. [10]	USA	16.8%, N - 5396	2006
8)	Shah., *et al*. [11]	Pakistan	36.5%, N-14490	2008
9)	Sapkota., *et al*. [12]	Kathmandu, Nepal	19%, N - 4282	2008
10)	Krishnaiah., *et al*. [13]	India	34.6%, N-3642	2009
11)	Ip., *et al*. [14]	Australia	11.9%, N- 2353	2010
12)	Logan., *et al*. [15]	England	29.4%, N - 327	2011
13)	Hsu., *et al*. [16]	Taiwan	36.4%, N- 11590	2016
14)	Gopalakrishnan A., *et al*. [17]	India	17.5%, N - 14342	2021
15)	Tongtong Li., *et al*. [18]	China	54.71%, N - 864828	2023

Table 1: *Worldwide prevalence of myopia.*

As above table summarized that the prevalence of myopia is increasing year by year. In 2002 the prevalence of myopia was 1.2% and in 2023 Tong Tong Li., *et al.* reported that the prevalence of myopia was 54.7%.

Another study is also reported that the prevalence of myopia in New Delhi (2002) is 7.4%. In Asian country the prevalence of myopia is also increased except Pokhra city of Nepal. In India it is also reported the prevalence of myopia is increased in recent years.

Types of myopia: There are several subcategories which define the types of myopia. All type of myopia defines given below:

- **Congenital myopia:** Congenital myopia is associated with an increase in the globe's overall size and axial length. It occurs in infants who had multiple birth defects, including homocystinuria and Marfan's syndrome, or who were born prematurely.
- **Developmental myopia:** The most common type is called simple or developmental myopia, sometimes referred to as physiological myopia. It is considered a physiological error that has nothing to do with eye issues. It is also known as school myopia because it typically manifests between the ages of 8 and 12 when a person starts school. In general, 29% of people have low myopia (≤2D), and 7% have moderate myopia (between 2 and 6 D).
- **Pathological myopia:** As the name suggests, pathological myopia is a rapidly progressive error that begins in childhood, between the ages of 5 and 10, and progresses to high myopia (7-6) D in early adulthood. This condition is typically linked to degenerative changes in the eye.
- **Acquired myopia:** Some of causes of acquired myopia are as follows:
- **Axial myopia:** Axial myopia is the result of a rapid increase in axial length. Each diopter increase in myopia causes an increase in axial length of 0.35 millimetres [19].
- **Curvature myopia**: An increase in corneal curvature leads to curvature myopia. There is a six-dioptre shift in myopia for every millimetre that the cornea's radius of curvature changes [20].

- **Lenticular myopia:** An increase in the crystalline lens's refractive index causes lenticular myopia [21]
- **Positional myopia and other conditions**: Anterior shifting of the crystalline lens can cause myopia [22]. Several disorders, such as choroidal effusion and anterior rotation of the ciliary body brought on by medications, such as topiramate, can cause the anterior shift of the lens-iris diaphragm, which can cause sudden onset myopia [23].

Mechanism behind myopia

The complex interactions between genetic and environmental factors that lead to changes in the structure and optics of the eye are responsible for the development of myopia. The elongation of the eyeball, which results in light entering the eye and focusing in front of the retina rather than directly on it, is the main mechanism underlying myopia. This elongation is linked to modifications in the size and form of different eye components. The following are the main elements and working mechanisms:

- **Eyeball elongation:** The main cause of myopia is the elongation of the eyeball. The axial length, or the distance between the front and back of the eye, is where this elongation mostly happens. The eyeball lengthens in myopia compared to people with normal vision.

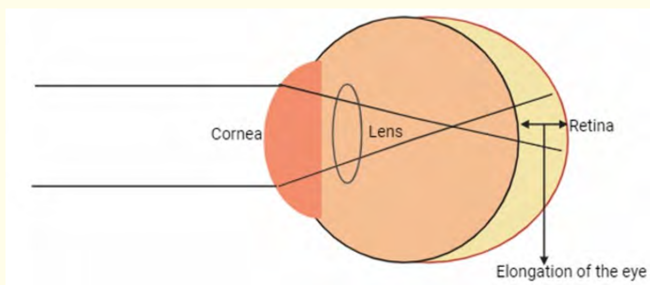

Figure 1: *Eyeball elongation that causes myopia.*

- **Hormonal changes:** The hormone imbalance also cause myopia that explained in below paragraph:
- **Dopamine:** Vision-induced ocular growth and development is mediated by the retinal neurotransmitter dopamine, which is released by dopaminergic amacrine cells [24]. The dopaminergic system is essential for the growth of the eyeball and the development of refractive errors. Dopamine metabolism is light dependent. Light-dependent dopamine release and its receptor inhibit myopia.
- **Insulin and glucagon**: It is becoming more widely known that insulin directly stimulates ocular growth and may also increase ocular elongation and scleral glycosaminoglycan (GAG) synthesis [25] Insulin injections can increase myopia, reduce hyperopia, and result in significant axial myopia (AL) when used with a negative lens. When it comes to glucose homeostasis, glucagon has the opposite effect on growth in the eyes as insulin does. Insulin may accelerate the process of eye elongation, while glucagon may thicken the choroid [26].
- **Genetic changes:** Myopia largely stems from genetics. The occurrence of myopia in a person may be influenced by certain genes linked to eye development, eyeball growth, and regulation of eye tissue**.**336 new genetic loci, including TCF4, LCAT, PAX6, LTBP2, FBN2, and DRD1, that are positively correlated with refractive errors have been found by several researchers. Additionally, teenagers with APLP2 gene mutations have an increased risk of developing myopia, according to research [27].
- **Accommodation:** The ability of the eyes to change focus is referred to as accommodation. Extended periods of close work can result in prolonged accommodation, which can exacerbate myopia. Research on the detailed connection between myopia and accommodation is still ongoing.

Factor causing myopia: Genetic and environmental factors work together to influence the development of myopia. The following are some major variables that lead to the development of myopia:

- **Genetics:** Hereditary are the major factors that cause myopia, if even one parent has this condition children develop myopia. When both parents are myopic then there is a high chance of developing myopia. A recent meta-analysis of 16 studies looking at the relationship between parental myopia and juvenile myopia found that children who have one myopic parent (OR = 1.87) or two myopic parents (OR = 2.40) are statistically significantly more likely to develop myopia [28]. Numerous researchers have discovered 336 new genetic loci that are positively correlated with refractive errors, including TCF4, LCAT, PAX6, LTBP2, FBN2, and DRD1. Furthermore, studies have shown that young adults with APLP2 gene mutations are more likely to develop myopia [29].
- **Environmental factors:** Myopia is largely influenced by environmental factors, and there is a correlation between the prevalence of nearsightedness and various aspects of contemporary lifestyles. The following environmental factors have been linked to myopia:
- **Limited outdoor activities:** It has been shown that spending more time outside can prevent incident myopia from developing [30], it has been suggested by animal research that UV light stabilizes the sclera, preventing axial elongation [31]. Higher average daily light exposure was linked to slower eye growth, according to studies; 40 minutes a day of intense light (>3000lux) exposure was associated with a noticeably slower rate of eye growth [32]. Between 2002 and 2015, a total of 51 articles were published. They concluded that more time spent outside can prevent myopia from starting but not from progressing.
- **Near work activities:** Myopia can develop because of engaging in activities like reading, using computers, and playing video games that require a prolonged and sustained focus on close objects. This kind of stress is commonly called "near-work-induced stress."In a study involving 210 Chinese children ages 8 to 9, Saw., *et al*. discovered that children with myopia engage in more near-work activities overall (2.7± 0.7 hours/day) than children without myopia (2.3± 1 hours/day) (p = 0.0027) [33]. According to ten studies, children between the ages of six and eighteen who participate in more near-work activities seem to be more likely to develop myopia [34].
- **Educational pressure:** Myopia may develop because of intense academic pressure and an emphasis on close-up vision tasks like reading and studying, especially in societies that place a high value on academic achievement. Myopia appears to be more common in East Asian cities due to a combination of changing lifestyles that have decreased children's outdoor playtime and growing educational pressures [35]
- **Screen time:** The development of myopia may be aided by the rising use of digital gadgets such as computers, tablets, and smart phones. Extended usage of screens can result in more eye strain and fewer outdoor activities**.** The combined effect of near work, which included computer use, reading time, and reading distance, increased the odds of myopia at age nine [36]. The American Academy of Pediatrics recommends limiting screen time for kids between the ages of two and five to one hour each day of high-quality content. The organization recommends consistent limits for kids six years old and up, but it doesn't include any specific amount [37].
- **Ethnic group:** Myopia tends to be more common in East Asians than in many other ethnic groups. According to a study, myopic progression progressed more quickly in Asian American children than in Native American, Black, or Hispanic children, and in girls of all racial and ethnic backgrounds at younger ages [38].
- **Food habit:** There is still more research to be done on the relationship between eating patterns and myopia. While there isn't a single food that can cure or prevent myopia, eating a healthy, balanced diet can help to maintain the health of your eyes overall. Certain researchers claim that non-vegetarians seem to have a lower prevalence of myopia than vegetarians [39,40].

Management of myopia

Currently, there are many ways to manage myopia, including as prescription drugs, lifestyle changes, optical corrections, and, more recently, light therapy (Figure 2) [41]. A straight forward, methodical strategy in a few steps that may be used in any myopia clinic to manage the progression of myopia.

Figure 2: *Flow diagram explains the meaning of IMPACT.*

- **Identify true axial myope:** Using techniques like cycloplegic refraction, keratometry readings, and/or axial length measures, the first step is to rule out refractive and other secondary myopia. Regardless of the age or severity of myopia, it is imperative to consistently correlate refractive error with axial length to guarantee that curvature or pseudo myopia is ruled out before to beginning any myopia control regimen.
- **Map the risk factors:** Understanding the variables influencing the onset or advancement of myopia would be made possible by obtaining a thorough medical history pertaining to myopia and by comprehensively recording a variety of risk factors.
- **Pick progressive myope:** Patients who have increasing axial length and/or progressive myopic refraction are good candidates for the myopia control procedure. A person may be diagnosed with progressive myopia if their axial length increases by more than 0.1 mm, or their myopic refraction increases by 0.50 D or more over the course of a year.
- **Appropriate treatment strategy:** It is best to choose a customised management strategy, which entails taking each patient's risk factors into account and then determining the best course of action to counteract those risk factors that could potentially trigger an event.
- Treatment options for optical myopia control, such as defocus spectacles, multifocal centre-distance soft contact lenses, and orthokeratology, are primarily designed to induce myopic defocus in the peripheral retina; therefore, they may be appropriate for myopes with relative peripheral hyperopia, as determined by peripheral refraction.

- For people with esophoria or excessive accommodative lag, extended depth of focus contact lenses, progressive addition lenses, or bifocals may be suggested to relax accommodation for close viewing. Selecting a myopia management strategy should be determined by carefully assessing each risk factor individually and taking each option's effectiveness, cost, medical needs, and side effects into account.

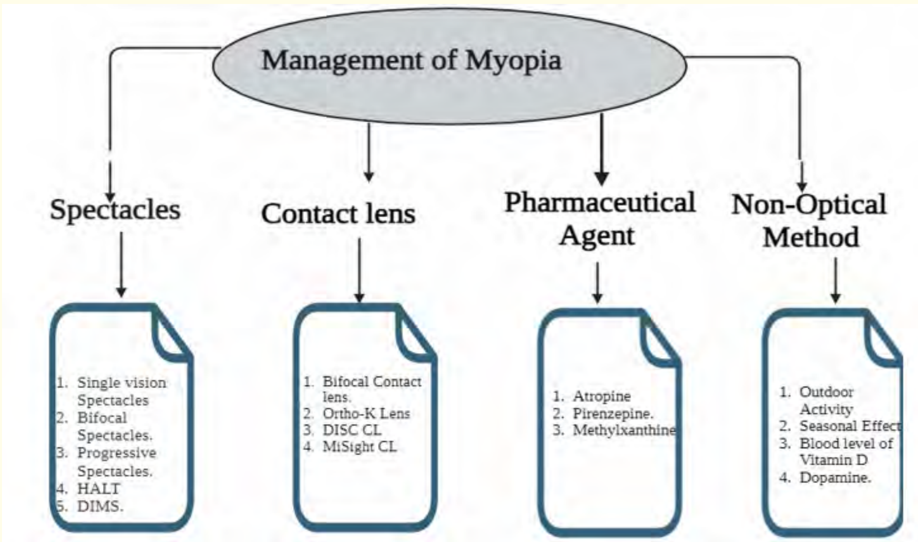

Figure 3: *Classification of the management modalities of myopia.*

- **Consult, counsel, combine and monitor closely:** Following the start of treatment, compliance with myopia control must be regularly monitored. At the very least, a follow-up appointment should be planned every six months until the progression of myopia is under control.
- **Tapering and cessation of the myopia control treatment:** It is advised that the patient wait until they are between the ages of 17 and 18 (usually in their late teens) before considering stopping or reducing the course of treatment to prevent myopia from progressing further, unless there are any complications. For example, the age at which myopia control medication should be discontinued can be compared to the age at which refractive surgery is typically recommended.

Literature Review

According to the research myopia risk factors are genetics, limited outdoor activities, and having a high level of education are the three main causes of myopia.

Since the initial attempt to identify the genetic causes of myopia in the 1960s, research conducted globally has made significant strides toward understanding the genetic basis of the condition.

G. Morgan conducted a study titled "IMI Risk Factors for Myopia" in which twenty-five myopia loci have been identified through linkage analyses, association studies, and next- generation sequencing; of these, eight have been replicated in multiple racial groups, seven have only been found in Caucasians, and ten have only been reported in Chinese people [42].

Andrei V. T Katchenko conducted a study "APLP2 Regulates Refractive Error and Myopia Development in Mice and Humans "which identified 336 novel genetic loci, such as TCF4, LCAT, PAX6, LTBP2, FBN2, and DRD1, that exhibit a positive correlation with refractive errors. Moreover, research has demonstrated that young adults who have mutations in the APLP2 gene are at a higher risk of developing myopia [43].

A study found that to achieve a 50% reduction in incident myopia, one must spend an extra 76 minutes per day outside in comparison to control or baseline levels. It should be noted, though, that the analysis only considered studies Saw., *et al*. 2006; French., *et al*. 2013 in "Time spent in outdoor activities in relation to myopia prevention and control" where the increase in time spent outside ranged from 1 to 9.8 hours per week. As a result, it is still unknown whether time spent outside has any protective effects beyond this upper limit. Because the prevalence of myopia was too low at baseline.

He., *et al*. (2015) in "Effect of Time Spent Outdoors at School on the Development of Myopia among Children in China" did not investigate the preventive effect of outdoor activities on baseline myopes. Wu., *et al*. (2013) in "Outdoor activity during class recess reduces myopia onset and progression in school children" have demonstrated that engaging in outdoor activities has a noteworthy impact on myopic shift in children who are not myopic, but not in those who are. For non-myopic eyes, outdoor time seems to have had a stronger impact than for myopic eyes. Increased outdoor time has a protective effect against the onset of myopia, but not its progression [44].

There is enough research to support the suggestion that children who read less will be less likely to develop myopia. Most of the studies were observational with only one RCT, which detracts from the quality of the evidence [45]. According to Sonia Peñarrocha Oltra in "Laser based refractive surgery techniques to treat myopia in adults. An overview of systematic reviews and meta analyses" each additional diopter-hour of NW per week increases the risk of myopia in children by 2%. Children aged 6 to 18 were used appropriately, as this age group has the highest rate of myopia development and progression [46], according to certain research, myopia development is correlated with the amount of time spent on near tasks [47,48]. Two studies, SAVES and X-PRES, found no connection between the onset of myopia and the amount of time spent on near tasks [49,50].

Methodology

Study design: This Study was a cross-sectional, Clinic based study among general routine patient visit. The study included all the patient who agreed to participate in this study.

Place of study: This study was conducted at Curesee clinic, Gurugram, Haryana 122001) Gurgaon.

Study duration: It was conducted between January to December month of 2024.

Sample size: It was included 362 participants.

Target population: Physiological myopia age between 18 to 30 years

Selection of subjects

Inclusion criteria: Physiological myopia age between 18 to 30 years

Exclusion criteria: The following subjects were excluded from the study:

- Subjects had pathological myopia.
- Other ocular abnormalities.

- Those who had any ocular surgery.
- Those who had any syndrome.

Research procedure

Approximately, 362 Patients was examined in clinic of Curesee Gurugram, Haryana 122001) from Different region of Gurgaon age group 18 to 30 years with refractive error selected. After doing objective refraction, a subjective refraction myopic patient is selected. Then the subjects will divide into different groups according to the age or causative factor that causes myopia.

The purpose and method of study were clearly explained to the subjects. Data will be collected with the help of Cure see Clinic. Data included subjects' age, gender, parent history, visual acuity, refractive error, weight, height, food habits, and lifestyle.

All the assessments were done by the same examiner, we also make a separate format of examination to collect detailed data from patients.

Subjects passing the inclusion criteria were included in this study after obtaining written consent from them. All the included subjects underwent a comprehensive eye examination to ensure their eligibility for the study.

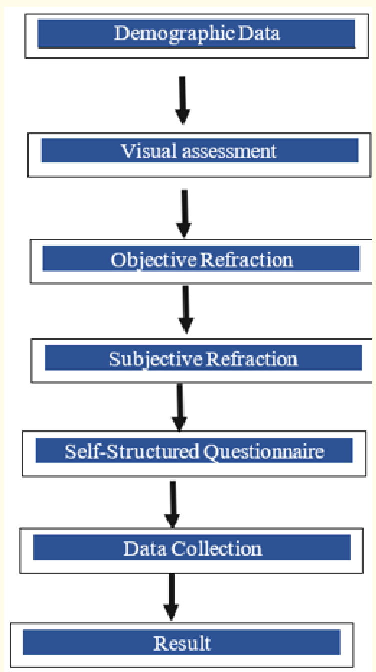

Figure 4: *Steps of research procedure.*

Study tools

- **Examination format:** Ocular Examination with the new format.
- **Snellen's chart:** It is used for measuring distance visual acuity.
- **Near vision chart:** A near vision chart is used to assess near visual acuity.

- **Retinoscopy:** Hyien beta retinoscopy is used. It is an instrument by which we determine the status of refractive error.
- **Trial box:** Required in subjective refraction.
- **Questionnaire format:** To know about the cause of myopia.

Result

Out of 362 in which, Mild Myopia: 93 cases (25.69%), Moderate Myopia: 64 cases (17.68%), High Myopia: 17 cases (4.70%), Normal 188 cases (51.93%) of the sample (Figure 5). One notable observation is that a majority of the sample (51.93%) reports no refractive error. Among those with refractive errors, mild myopia is the most common, followed by moderate myopia, and then high myopia, with the prevalence decreasing in that order.

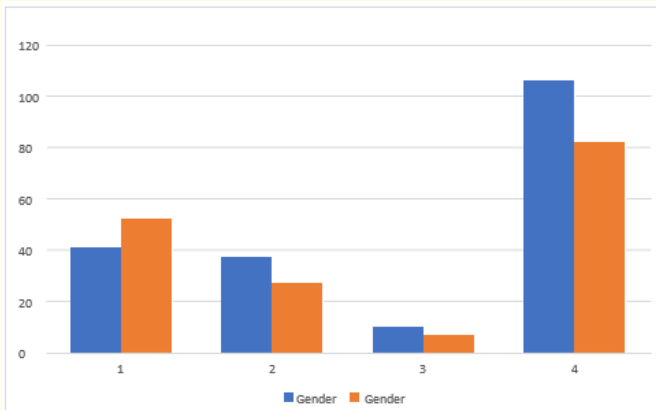

Figure 5: *Figure showing prevalence of refractive error.*

The distribution of gender in which Female: 46.41% (168 out of 362), Male: 53.59% (194 out of 362) (Figure 6).

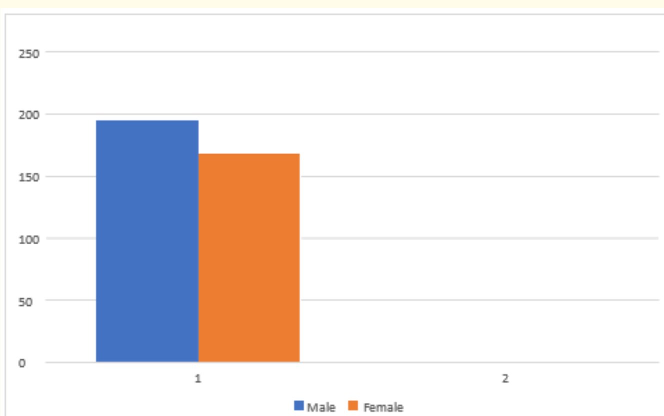

Figure 6: *Figure showing gender distribution.*

In the table 2 data shows that there are slight variations in the distribution of refractive errors between males and females, but these variations are not statistically significant as indicated by the P value of 0.102. Therefore, gender does not appear to be a major factor in the distribution of refractive error.

			Refractive error		Total		
		Mild Myopia	Moderate	High Myopia	None		P-Value
Gender	Male	41	37	10	106	194	0.102
	Female	52	27	7	82	168	
Total		93	64	17	188	362	

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.613[a]	3	0,202
Likelihood Ratio	4,608	3	0,203
Linear-by- Linear Association	2,674	1	0,102
N of Valid Cases	362		

Table 2: *Showing the comparison between refractive error and gender.*

Figure 7 gives an overview of the prevalence of refractive error within the family histories of the individuals surveyed. Myopia in both parents: 15 cases (Mild Myopia 2, Moderate Myopia 11, High Myopia 2, None 0), Myopia in the father only: 15 cases (Mild Myopia 4, Moderate Myopia 09, High Myopia 0, None 2), Myopia in the mother only: 47 cases (Mild Myopia 5, Moderate Myopia 21, High Myopia 11, None 10). No reported family history of myopia: 285 cases, (Mild Myopia 82, Moderate Myopia 23, High Myopia 4, None 176) of the sample. It seems like myopia is more prevalent overall, with mothers having the highest reported incidence among the parents.

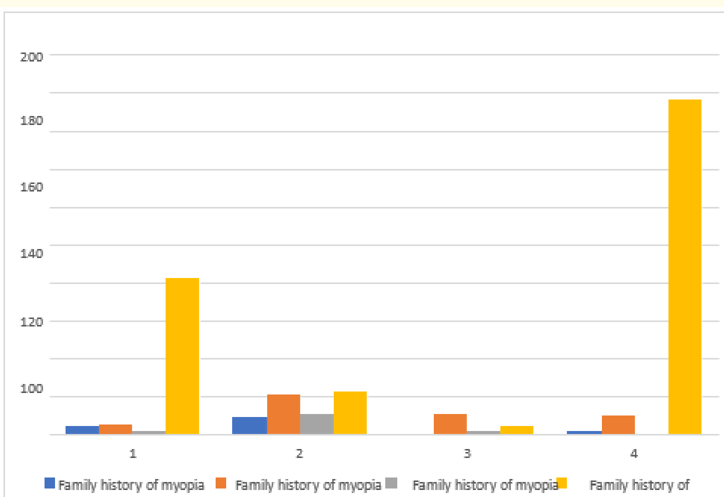

Figure 7: *Figure showing distribution of refractive error within a family history.*

The data indicates a significant association between family history and the occurrence of refractive errors. Specifically, having both parents with myopia is strongly associated with higher occurrences of moderate myopia. In contrast, individuals with no family history of refractive error are predominantly without refractive errors. The P value of less than 0.001 suggests that these associations are statistically significant (Table 3).

Family history of myopia * Refractive error Crosstabulation							
Count							
Mild Myopia		Refractive error				Total	
		Moderate	High Myopia	None		P-Value	
Family history of myopia	Father	4	9	0	2	15	0.000
	Mother	5	21	11	10	47	
	Both	2	11	2	0	15	
	None	82	23	4	176	285	
Total		93	64	17	188	362	

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	152.425[a]	9	0,000
Likelihood Ratio	131,120	9	0,000
Linear-by-Linear Association	12,353	1	0,000
N of Valid Cases	362		

Table 3: *Showing the comparison between refractive error and family history.*

Figure 8 provides information on the food habits of individuals. Non-Vegetarian: 164 cases, this group shows the highest prevalence of mild myopia is 27.44% and a relatively high prevalence of moderate myopia is 21.34%, The prevalence of high myopia is low is1.83%, and 49.39% have no refractive error. Semi-Vegetarian: 49 cases, this group has the highest prevalence of moderate myopia (22.45%) among all groups and a significant prevalence of high myopia (12.24%). A smaller percentage (44.90%) have no refractive error compared to vegans and vegetarians.

Vegan: 19 cases, this group has a relatively low prevalence of refractive errors, with 57.89% having no refractive error. Mild and moderate myopia each have a prevalence of 21.05%, and there are no cases of high myopia. Vegetarian: 130 cases, this group shows a higher prevalence of mild myopia (26.15%) compared to vegans. The prevalence of high myopia (6.15%) is slightly higher than in vegans. However, 56.92% of vegetarians have no refractive error, similar to vegans. Most individuals are either non-vegetarian or vegetarian, with a smaller percentage identifying as semi-vegetarian or vegan.

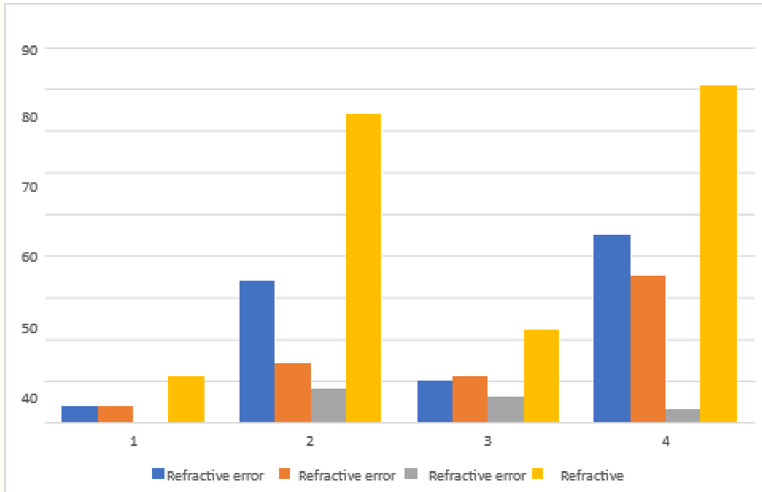

Figure 8: *Figure showing distribution of food habitat in a sample population.*

The data shows varying distributions of refractive errors among different food habitats, but the P value of 0.164 indicates that these differences are not statistically significant. This means that the type of diet (non-vegetarian, semi-vegetarian, vegan, or vegetarian) does not significantly influence the distribution of refractive errors (Table 4).

		Refractive error				**Total**	
		Mild Myopia	**Moderate**	**High Myopia**	**None**		**P-Value**
Food Habitat	Vegan	4	4	0	11	19	0.167
	Vegetarian	34	14	8	74	130	
	Eggetarian	10	11	6	22	49	
	Non vegetarian	45	35	3	81	164	
Total		93	64	17	188	362	

Chi-Square Tests			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	18.126[a]	9	0,034
Likelihood Ratio	18,488	9	0,030
Linear-by-Linear Association	1,914	1	0,167
N of valid cases	362		

Table 4: *Showing the comparison between refractive error and food habitat.*

Figure 9 provides information on the residential areas of individuals surveyed, in which Rural: 186 cases, many individuals (60.22%) have no refractive error, Mild myopia (24.73%) is more common than moderate (12.90%) and high myopia (2.15%). Semi-Urban: 45 cases, Mild myopia (40.00%) is the most prevalent refractive error, there are no cases of high myopia, and 48.89% have no refractive error. Urban: 131 cases this group has the highest prevalence of moderate myopia (26.72%) and high myopia (9.92%), Mild myopia (22.14%) is also significant, and 41.22% have no refractive error.

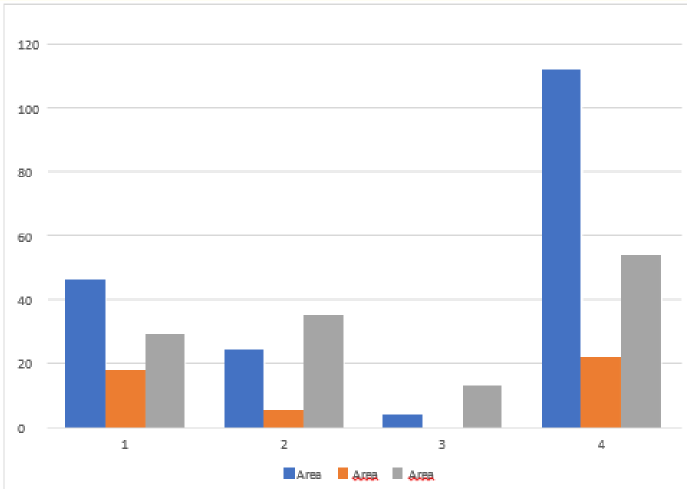

Figure 9: *Figure showing area of patient living.*

The analysis shows significant differences in the prevalence of refractive errors across different areas, with urban areas having higher rates of moderate and high myopia, and rural areas having the highest proportion of individuals without refractive errors (Table 5).

		Refractive error				**Total**	
		Mild Myopia	**Moderate**	**High Myopia**	**None**		**P-Value**
Area	Rural	46	24	4	112	186	0.052
	Town	18	5	0	22	45	
	Urban	29	35	13	54	131	
Total		93	64	17	188	362	

Chi-Square Tests			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	31.582[a]	6	0,000
Likelihood Ratio	31,685	6	0,000
Linear-by-Linear Association	3,762	1	0,052
N of Valid Cases	362		

Table 5: *Showing the comparison between refractive errors and area.*

Figure 10 provides information on the Body Mass Index (BMI) categories of individuals surveyed, High BMI: 35 cases, the high BMI group exhibits a high prevalence of mild myopia (51.43%) and moderate myopia (28.57%), while none of the individuals in this group have high myopia, and 20% have no refractive error. Low BMI: 19 cases, this group shows a significantly higher proportion of high myopia (47.37%) compared to mild myopia (15.79%) and moderate myopia (26.32%). Only 10.53% have no refractive error. Normal BMI: 308 cases, many individuals in the normal BMI category have no refractive error (58.44%), followed by mild myopia (23.38%) and moderate myopia (15.91%). Only 2.60% have high myopia.

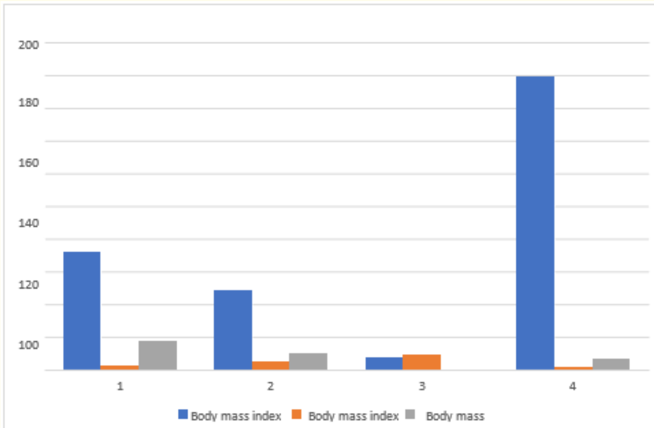

Figure 10: *Figure showing health status of the individual.*

The data indicates that there is a statistically significant association between BMI and refractive error (P value < 0.001). This means that the distribution of refractive errors varies significantly with different BMI categories. Specifically: Individuals with normal BMI predominantly have no refractive error. Individuals with high BMI are more likely to have mild or moderate myopia. Individuals with low BMI have a higher likelihood of moderate and high myopia. This suggests that BMI could be an influential factor in the development of refractive errors (Table 6).

		Refractive error				Total	
		Mild Myopia	Moderate	High Myopia	None		P-Value
Body mass index	Normal	72	49	8	179	308	0.000
	Low	3	5	9	2	19	
	High	18	10	0	7	35	
Total		93	64	17	188	362	

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	107.706[a]	6	0,000
Likelihood ratio	64,364	6	0,000
Linear-by-linear association	22,101	1	0,000
N of valid cases	362		

Table 6*: Showing the comparison between refractive error and BMI.*

Table 7 showing the comparison between refractive error and age, outdoor activity, indoor activity and screening time.

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound			
Age	Mild Myopia	93	22,22	2,181	0,226	21,77	22,66	18	28
	Moderate	64	22,09	2,402	0,300	21,49	22,69	18	27
	High Myopia	17	21,53	1,841	0,447	20,58	22,48	18	24
	None	188	22,10	2,062	0,150	21,80	22,40	18	27
	Total	362	22,10	2,143	0,113	21,88	22,32	18	28
Outdoor Activity	Mild Myopia	93	1,43	0,559	0,058	1,31	1,55	1	4
	Moderate	64	1,56	0,871	0,109	1,35	1,78	1	4
	High Myopia	17	1,18	0,393	0,095	0,97	1,38	1	2
	None	188	2,03	0,956	0,070	1,89	2,16	1	5
	Total	362	1,75	0,883	0,046	1,66	1,84	1	5
Indoor activity	Mild Myopia	93	3,56	0,878	0,091	3,38	3,74	2	5
	Moderate	64	3,84	0,718	0,090	3,66	4,02	2	5
	High Myopia	17	3,35	0,931	0,226	2,87	3,83	2	5
	None	188	3,16	0,881	0,064	3,03	3,29	1	5
	Total	362	3,39	0,894	0,047	3,30	3,48	1	5
Screening Time	Mild Myopia	93	2,41	0,837	0,087	2,24	2,58	1	4
	Moderate	64	2,33	0,837	0,105	2,12	2,54	1	4
	High Myopia	17	2,12	0,993	0,241	1,61	2,63	1	4
	None	188	1,84	0,774	0,056	1,72	1,95	1	4
	Total	362	2,08	0,851	0,045	1,99	2,17	1	4

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Age	Between Groups	6,767	3	2,256	0,489	0,690
	Within Groups	1650,452	358	4,610		
	Total	1657,218	361			
	Between Groups	31,741	3	10,580	15,158	0,000
	Within Groups	249,883	358	0,698		
	Total	281,624	361			
Indoor activity	Between Groups	25,841	3	8,614	11,749	0,000
	Within Groups	262,457	358	0,733		
	Total	288,298	361			
Screening Time	Between Groups	25,278	3	8,426	12,769	0,000
	Within Groups	236,235	358	0,660		
	Total	261,514	361			

Table 7

Outdoor activity: Scores are lowest for individuals with high myopia (mean = 1.18) and mild myopia (mean = 1.43), suggesting that these groups are likely to engage in less outdoor activity compared to the group with no refractive error (mean = 2.03). The p-value for the ANOVA test for outdoor activity is 0.000, which is statistically significant ($p < 0.05$). This indicates that the amount of outdoor activity significantly differs across the refractive error categories. Individuals with refractive errors, particularly myopia, tend to engage in less outdoor activity. The absence of refractive error is associated with higher levels of outdoor activity.

Indoor activity: Scores are highest in the moderate myopia group (mean = 3.84), followed by mild myopia (mean = 3.56), and lowest in the no refractive error group (mean = 3.16). The p-value for the ANOVA test for indoor activity is 0.000, which is statistically significant ($p < 0.05$). This means that individuals with different refractive errors significantly differ in their indoor activity levels. Those with refractive errors, particularly moderate myopia, are likely to spend more time on indoor activities, while individuals with no refractive error engage less in indoor activities.

Individuals with mild myopia spend the most time on screening (mean = 2.41), followed by those with moderate myopia (mean = 2.33) and high myopia (mean = 2.12). The group with no refractive error spends less time on screening (mean = 1.84). the p-value for the ANOVA test for screening time is 0.000, which is statistically significant ($p < 0.05$). This suggests that the time spent on screening significantly varies across the refractive error categories. Individuals with refractive errors, especially mild and moderate myopia, tend to spend more time on screening, whereas those without refractive errors spend less time on screening.

Discussion

Myopia is a refractive error in which parallel rays of light are focus in front of retina when the accommodation is at rest. There are mainly two types of myopia physiological and pathological myopia, A correlation failure of the refraction components in a normal eye leads to physiological myopia [51]. Pathological myopia has a specific pathology at the posterior, such as Foster-Fuchs's spot, Cystoid degeneration, Liquefaction, Macular degeneration, Vitreous opacities, Weiss's reflex, Posterior staphyloma, etc. it is also known as degenerative myopia.

The emphasis on physiological myopia in research and clinical practice, as opposed to pathological myopia, is primarily due to its higher prevalence and significant public health impact. A significantly larger proportion of the population suffers from physiological myopia, which frequently develops during childhood and adolescence because of natural eye growth and environmental factors.

Previous Studies says that the prevalence of myopia has shifted from males in previous generations to females in the current young generation [52]. But this study shows that Gender does not appear to be a major factor in the refractive error. There is only few studies who compare between refractive error and gender.

When both parents have myopia, the likelihood of developing the condition increases, several studies have found that the parents' refractive error is the most important predictor of the development of myopia [53]. Furthermore, our findings support previous having both parents with myopia is strongly associated with higher occurrences of myopia.

One study revealed the odds of myopia co-existing in the vegetarian participants to have been 1.28 times that compared to those in the non-vegetarian participants [54]. But this study, shows that the type of diet (non-vegetarian, semi-vegetarian, vegan, or vegetarian) does not significantly influence the distribution of refractive errors.

Several epidemiological studies have shown that myopia is more common in urban areas, among professionals, educated patients, computer users, university students, and associated with increased intelligence [55,56]. This study shows that the presence of refractive errors, particularly myopia, is associated with reduced outdoor activity, while the absence of refractive errors correlates with higher levels of outdoor activity. These results underscore the importance of considering refractive error status in promoting outdoor activities, especially for individuals with myopia.

Several studies using body mass index (BMI) have found a link between obesity and myopia [57,58]. The relationship between BMI and myopia has generated some debate. While some research has shown that people who are obese typically have myopia [59], other studies have found the opposite [60]. This study shows that the distribution of refractive errors varies significantly with different BMI categories. Specifically: Individuals with normal BMI predominantly have no refractive error. Individuals with high BMI are more likely to have mild or moderate myopia. Individuals with low BMI have a higher likelihood of moderate and high myopia. This suggests that BMI could be an influential factor in the development of refractive errors.

Several studies have found a positive correlation between screen time exposure and myopia [61], while others have found no link [62]. This study suggest that individuals with refractive errors, particularly those with mild and moderate myopia, tend to engage in more screen time compared to those without refractive errors. This information highlights the need to consider refractive error status when addressing screen time habits and suggests potential areas for intervention to mitigate excessive screen time, especially for individuals with myopia.

Several studies found that protective effect on incident myopia with increasing outdoors activity during school recess [63,64]. In this study, we found that error, Individuals with mild myopia have the lowest mean outdoor activity. Individuals with no refractive error have the highest mean outdoor activity.

Among 15 cross-sectional studies examining the prevalence of myopia and the effect of indoor activity, 10 studies reported increased prevalence myopia with increased indoor activity among 6-18 years old children [65]. This study shows the similar result, Individuals with high myopia have the highest mean indoor activity. Individuals with no refractive error have the lowest mean indoor activity.

Limitation of the Study

1. Population size is limited.
2. Shorts duration of data collection.
3. A longer duration of data collection could yield more reliable results.

Conclusion

This study emphasises the higher prevalence and public health importance of physiological myopia. It concludes that gender has no significant impact on the development of myopia, contradicting previous research. However, having myopic parents is still a strong predictor of the condition. The type of diet has no correlation with refractive errors, but BMI does: normal BMI is associated with no refractive error, high BMI with mild to moderate myopia, and low BMI with moderate to high myopia. Screen time and indoor activity are linked to increased myopia, whereas outdoor activity has a protective effect. The study emphasises the complexities of myopia development, specifically the roles of genetic predisposition, environmental exposure, lifestyle choices, and physical health. This comprehensive approach sheds light on targeted interventions and preventive measures to address the growing prevalence of myopia.

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