

## INTRODUCTION

Uncorrected errors of refractions have become one of the major important public health problems worldwide nowadays. They include myopia, hyperopia and astigmatism. Myopia, or near-sightedness, is the state of refraction in which parallel rays of light are brought to focus in front of the retina of a resting eye.<sup>(1)</sup> It is a significant public health problem, affecting 33% of individuals over the age of 12 years in the United States.<sup>(2)</sup> There are four clinical varieties of myopia: congenital, simple myopia, pathological, and acquired myopia. Simple myopia or school myopia, which is the commonest type, begins at 7 or 10 years (school age) and progresses till the midteens when it becomes stable at -5 D but never exceeds -8 D.<sup>(3)</sup>

Hyperopia, or far-sightedness, is an ocular disorder in which the optical power of the eye is very weak. It is categorized by the degree of refractive error into: Low hyperopia is +2.00D or less, Moderate hyperopia ranges from +2.25 to +4.00D, and High hyperopia is more than +4.00D but rarely reach +8 D.<sup>(4)</sup> Astigmatism is a condition in which the eye can't form a point image for a point object because of the differences in the meridians. It has 3 types: simple, compound and mixed, it also occurs in both myopic and hyperopic people. It may be due to either corneal irregularities or lenticular ones and it causes blurring of vision for all distances (near and far).<sup>(5)</sup>

World health organization (WHO) categorized vision (according to international classification of diseases 10<sup>th</sup> revision “ICD-10”) into: normal vision or mild visual impairment (presenting visual acuity “VA” in the better seeing eye, 6/6 - 6/18), moderate visual impairment (< 6/18 – 6/60), severe visual impairment (< 6/60 - 3/60), and blindness (< 3/60 - no perception of light “NPL”).<sup>(6)</sup> Moderate and severe visual impairment are termed “Low vision” while low vision and blindness are termed “Impaired vision”.<sup>(7)</sup>

In 2002, 161 million people globally have been reported to be visually impaired due to different eye diseases as cataract, trachoma and onchocerciasis (but errors of refractions as a cause was not included in such statistics).<sup>(8)</sup> But since then, the WHO and the International Agency for the Prevention of Blindness (IAPB), with the global initiative, VISION 2020: The Right to Sight, have done their best to include the uncorrected errors of refractions in such statistics due to their great importance in visual impairment occurrence. So on October 12, 2006, the WHO has revealed the magnitude of visually impaired people due to uncorrected errors of refraction to be 153 millions either blind or of low vision, with at least 13 million children (5-15% of children aged 5–15 years).<sup>(9,10)</sup> So, uncorrected errors of refractions become the second main cause of preventable blindness (18%) after the cataract (39%).<sup>(11,12)</sup>

Uncorrected refractive errors are a major problem in school children. They lead to inability to read what is written on chalkboard which greatly affects a children's learning process.<sup>(13)</sup> It has serious social effect on the child in school. Continuous blaming of the child as being lazy and stupid is very frequent by non-responsible teachers. These factors may lead to decrease the child's performance leading to recurrent school failure. A study formed in Brazil showed the great impact of refractive errors on the child's education. About 10% of these children are at higher probability of dropping out of school.<sup>(14)</sup>

They found also that the prevalence of visually impaired children due to the errors of refraction differs from rural to urban areas. The prevalence was of course higher in urban regions than rural ones despite the availability of more and better health services. This may be due to increasing the rate of education in urban areas than in rural regions, since there is a direct relation between increase the education level and myopia.<sup>(8)</sup>

Several factors contribute to decreasing rate of correction of refractive errors in children group age 5-15 years like lack of awareness of the problem at personal and family level and community level and lack of screening methods. However, cultural barriers and believes can play a role, as shown in studies from where free and easy routine screening program and aids to correct errors of refraction

are present.<sup>(15,16)</sup> Poor access to refractive services in rural children, despite the fact that refractive errors are less common amongst rural children has an important role.<sup>(17,18)</sup> Cosmetic factors also have a great problem as the spectacles make the child looks nerdy<sup>(16)</sup>. The age factor showing controversial effect on compliance of spectacles wear, increasing the age has minor negative effect in a study from Mexico, while it shows a positive effect in a study from rural china<sup>(19)</sup>. Non-compliant children who don't wear spectacles had an average academic score lesser than compliant peers. But, there could be confounders for this like intelligence quotient "IQ".<sup>(20)</sup>

A Tanzanian study showed that spectacles provided free of cost under insurance coverage, were used less as compared to those the patient pay for.<sup>(21)</sup> Non-availability of different types, shapes, colors, and sizes of spectacles is another cause, as only one size spectacles that fit all ages is considered unfashionable. Small refractive errors ( $< 1.0D$ ) might not be corrected as the children don't complaint of uncorrected visual acuity (UCVA) and do not use the spectacles.<sup>(22)</sup>

Few studies were also conducted in Egypt, but one of largest studies conducted in Cairo, the capital of Egypt, using a large sample (6000 children) from different governorates and socioeconomic classes has revealed the prevalence of refractive errors ( $VA \leq 6/12$ ) among school children to be 22.1%.<sup>(23)</sup>

## **AIM OF THE WORK**

**T**he aim of this study is to assess the prevalence of myopia among school children (from 5 to 15 years of age) referred to Ain Shams ophthalmology outpatient clinic.

## Myopia

The word myopia comes from a Greek word meaning closed eyes, and apparently referred to the squinting that nearsighted people resort to in order to see more clearly.<sup>(24)</sup>

Myopia is defined as that optical condition of the non-accommodating eye in which parallel rays of light entering the eye are brought to a focus anterior to the retina. It also can be described as the condition in which the far point of focus is located at some finite distance in front of the cornea. For practical purposes, this is a distance of less than 6 meters, the distance at which VA is normally tested. Thus, the uncorrected, non-accommodating myopic eye has some point at a finite distance beyond which objects are not seen clearly. At this far point, an object is in clear focus, but with increasing distances beyond it, the image becomes progressively more indistinct. This far point also is defined as the focal point of the eye. The degree of myopia in diopters is found by determining the reciprocal of the far point or focal point of the eye measured in meters.<sup>(25)</sup>

### **Definition of myopia in epidemiologic studies:**

Different studies have adopted different definitions of myopia. The most common definitions are a refractive error greater than 0.25 D and a refractive error greater than 0.50 D. The lack of uniform criteria has led to difficulties

in comparing prevalence rates in different studies. The "gold standard" for measurement of refractive error in children is cycloplegic refraction. Cycloplegia is the act of paralyzing the muscles of accommodation in the eye. Usually, cyclopentolate hydrochloride 1% eye drops are instilled, which provides cycloplegia with a peak effect around 45 minutes. Cycloplegic refractions especially important in children and infants, as they have strong accommodative responses which may lead to "pseudomyopia".<sup>(26)</sup>

### **Epidemiology of myopia:**

Myopia is a significant global public health concern with a rapid increase in prevalence in recent decades worldwide.<sup>(27)</sup>

Worldwide prevalence of myopia in children:

The Refractive Error Study in Children (RESCE) was conducted in different countries using the same sampling strategies, procedures to measure refraction and definitions of myopia, in order to compare the prevalence of myopia across different study populations.

In Nepal, the prevalence of myopia ranged from 10.9% in 10-year-old children, 16.5% in 12-year-olds, to 27.3% in 15-year-old children living in the urban region, whereas it was <3% in 5–15 year old children in rural Nepal.

In urban India, the prevalence of myopia was 4.7%, 7.0% and 10.8% in 5, 10 and 15 year-olds, respectively. On the other hand, the prevalence of myopia was 2.8%, 4.1% and 6.7% in 7, 10 and 15-year-olds, respectively in the rural region. Among urban Chinese children the prevalence of myopia ranged from 5.7% in 5-year-olds, 30.1% in 10-year-olds and increased to 78.4% in the 15-year-olds.<sup>33</sup> In rural parts of northern China, the prevalence of myopia was almost nil in 5-year-olds and steadily increased to 36.7% and 55.0% in 15-year-old males and females respectively.

In the rural region of Southern China, 36.8% of 13-year-olds, 43.0% of 15-year-olds and 53.9% of 17-year-olds were found to be myopic. In brief, the prevalence of myopia was highest (78.4%) in 15-year-old urban Chinese children and lowest (1.2%) in 5–15 year old rural Nepalese children.<sup>(28)</sup>

### **Prevalence and demographic patterns:**

There is considerable geographic variation in the reported prevalence of myopia. It is difficult to compare prevalence rates between countries based on previous studies; the definitions of myopia are not uniform, and refraction may have been performed without cycloplegia. Prevalence studies are not all population-based, with some studies being conducted on convenient select groups of individuals with limited generalizability. The prevalence of myopia varies with time and the age of the study population.<sup>(29)</sup>



Myopia not only shows regional variation in prevalence but also exhibits country specific differences in secular trends as well. A possible reason for the increase in myopia rates in many countries is the increase in formal education, with more time being spent on close-up work, in the past few decades. The prevalence of myopia has increased over the past several decades in Singapore and Japan. <sup>(30-31)</sup>

Sex and race also affect the distribution of myopia. The 1971 and 1972 NHANES (National Health and Nutrition Examination Survey) data showed that prevalence rates were higher in females than in males and higher in whites than in blacks in the United States. Certain ethnic groups, such as Asians and Jews, have a higher prevalence of myopia, whereas Africans and African Americans have a low myopia prevalence rate. <sup>(32)</sup>

### **Incidence and progression of myopia:**

There is a lack of adequate data on the incidence of myopia from population-based cohort studies. Longitudinal studies have found that myopia stops increasing earlier in females than in males, and that mean cessation ages range from 14.44 to 15.28 years for females and 15.01 to 16.66 years for males. <sup>(33)</sup> However, showed that even after puberty, myopia continues to progress slowly, and the increase in axial length is the main component in myopia progression. <sup>(34)</sup> Some studies have reported that a greater

amount of myopia at the initial examination age is associated with a greater rate of progression <sup>(33,35)</sup>. In a study of Finnish school children by Parssinen and Lyyra, myopia progressed faster in girls than in boys, in children with an earlier age of onset of myopia, and in children who had more severe myopia at initial examination. All of these studies have a potential bias in that they examined populations that self-referred for spectacle or contact lens correction of myopia. <sup>(36)</sup>

### **Theories of aetiology of myopia:**

Numerous studies have tried to elucidate the aetiology of myopia. However, the exact aetiology of myopia is still unclear. Myopia varies over age, gender, race, ethnicity, level of education, social class and degree of urbanization. <sup>(37)</sup> Educational level, intelligence, certain personality traits, and socioeconomic status have all been associated with myopia. <sup>(38)</sup>

Environmental factors depends on the use-abuse theory which views myopia as the result of habitual use of the eye at a near focal length, near-work. Myopia is therefore most common in advanced, literate societies and is rare in primitive, illiterate societies. This is not to say that an illiterate person could not develop myopia. Even an illiterate person might be spending hours each day in some form of close work requiring excessive accommodation that could lead to the development of myopia. <sup>(37)</sup>

Using data from the Health Examination Survey of 12 to 17-year-olds conducted by the US Public Health Service from 1966–1970, this paper found that the use-abuse theory can explain at least some of the variance of myopia and much of the socially patterned variance. This finding raises the possibility that at least some of the myopia extant in a population is preventable.<sup>(39)</sup> The prevalence of myopia in parts of South East Asia has risen dramatically over the past 1–2 generations, suggesting that environmental factors may be particularly important determinants of refractive development in these populations.

The biological theory of myopia views myopia as the result of genetically determined characteristics of eye tissues. Shared genes and/or shared environment are important factors in the refractive development of children in Singapore.<sup>(40)</sup> Recently, in European populations, some studies have suggested that additive genetic factors are responsible for over 80% of the variation in refractive error, leaving only a minor component that could be due to environmental factors to which people are variably exposed.<sup>(41)</sup> The use-abuse theory implies that myopia is preventable whereas the biological theory does not.<sup>(42)</sup>

However, it is difficult to separate hereditary factors from environmental factors such as similar work patterns in parents and their children.<sup>(43)</sup> The role of heredity is

postulated to be more significant in persons with higher degrees of myopia. Different modes of Mendelian inheritance, including autosomal dominant, autosomal recessive, and sex-linked, have been suggested by different authors.<sup>(44)</sup>

### **Risk factors for myopia:**

Risk factors that have been explored as possibly contributing to myopia onset and progression include prematurity, low birth weight, height, personality, and malnutrition. There is strong evidence for a link between prematurity and low birth weight and myopia, but unconvincing evidence for any association between myopia and height, personality, or malnutrition.<sup>(29)</sup>

Another risk factor for myopia is night-time light exposure during the first 2 years of childhood. Quinn and co-workers have reported an association between night-time light exposure during the first 2 years of childhood and subsequent myopia development (in a US population group attending a university paediatric ophthalmology outpatient clinic) the magnitude of which was so strong that it would be expected to dominate genetic factors in the aetiology of myopia.<sup>(45)</sup>

Some studies found a significant association between myopia and the number of hours of complete darkness to which young adults were currently exposed at

night.<sup>(46)</sup> However, more recent studies view that night-time light exposure during infancy is not a major risk factor for myopia development in most population groups.<sup>(41)</sup> A study found an association between recessive sex linked inherited external ophthalmoplegia and myopia.<sup>(47)</sup>

We would need no statistical evidence that glaucoma at birth or in early life often produces myopia because of a large eyeball. The eyes of children with unilateral ptosis are more myopic or less hypermetropic on the affected side than on the other. Cataracts in early life are also factors in causing abnormal elongation of the eyeball.<sup>(48)</sup>

Pneumatic caisson engineering has been developed for large civil engineering constructions. Because of complaints of blurred vision by personnel working in pneumatic caissons, the development of myopia was suspected. The blurred vision in pneumatic caisson workers was in all likelihood due to the development of myopia. The refractive shift towards hyperopia after completion of work in the pneumatic caisson supports this and demonstrates that the changes were temporary. The myopia is similar to the myopia seen in patients treated by hyperbaric oxygen.

Careful monitoring of the refraction of caisson workers should be performed for industrial health control. Late onset myopia developed in most workers who worked in a pneumatic caisson and most recovered from the

induced myopia six months after suspension of the work. It is possible that the lower levels of oxygen compared to medical hyperbaric treatment could cause the development of myopia in workers in high pressure. <sup>(49)</sup>

### **Types of myopia:**

1. **In axial myopia**, the AP diameter of the eye is longer than normal, although the corneal and lens curvatures are normal and the lens is in the normal anatomic position.
2. **In curvature myopia**, the eye has a normal AP diameter, but the curvature of the cornea is steeper than average (e.g., congenitally or in keratoconus), or the lens curvature is increased as in moderate to severe hyperglycemia, which causes lens intumescence.
3. **Increased index of refraction in the lens** due to onset of early to moderate nuclear sclerotic cataract is a common cause of myopia in elderly. Many people find themselves can read without glasses or having gained “second sight”.
4. **Anterior movement of the lens** is often seen after glaucoma surgery and will increase the myopic error of the eye. <sup>(50)</sup>

## **Diagnosis of myopia:**

Myopia is commonly classified into three groups: mild ( $\leq 3.0$  D), moderate ( $> 3.0$  D), and high ( $> 6.0$  D). Duke-Elder had suggested that high myopia, which is primarily caused by retinal pole, should be named pathologic myopia. <sup>(51)</sup>

## **Clinical picture of myopia:**

The primary symptom of myopia is poor distance vision. Children with simple myopia are often unaware that they have reduced distance vision until they discover that other children see better than they can. For example, many school children first notice that they cannot read the chalkboard as well as their classmates. For others who never report a problem, poor distance vision is first detected during vision screening or comprehensive eye and vision examination. <sup>(52)</sup>

For more details as regarding symptoms of myopia, clinical types of myopia are illustrated:

1. Simple myopia.
2. Nocturnal myopia.
3. Pseudomyopia.
4. Induced myopia
5. Degenerative myopia.