CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

Review of the related literature, helps the researcher to accustom himself with current knowledge in the field or area in which he is going to conduct his research, and provide the following specific purposes:

- The review of related literature enables the researcher to identify the limits of his/her field. It helps the researcher to define his problem.
- The researcher can avoid unprofitable and ineffective problem areas.
- The researcher can avoid accidental duplication of well established findings.
- The researcher can make use of the tools and can follow the procedure for validation of the tool.
- The researcher gain knowledge to choose the problem given in the previous research, as suggestions for further studies.

Studies have been classified in to 4 domains (2.2, 2.3, 2.4, and 2.5) and presented as follows.

2.2 Studies related to Prevalence of Refractive Error
2.3 Studies related to Refractive Error and Educational Performance
2.4 Studies related to Near work and Outdoor Activities and
2.5 Studies related to Heredity and Refractive Error.
2.2 STUDIES RELATED TO PREVALENCE OF REFRACTIVE ERROR

Dandona et al., made a research work on Refractive errors in an urban population in Southern India: the Andhra Pradesh Eye Disease Study Purpose: To assess the prevalence, distribution, and demographic associations of refractive error in an urban population in southern India. Methods: Two thousand five hundred twenty-two subjects of all ages, representative of the Hyderabad population, were examined in the population-based Andhra Pradesh Eye Disease Study. Objective and subjective refraction was attempted on subjects >15 years of age with presenting distance and/or near visual acuity worse than 20/20 in either eye. Refraction under cycloplegia was attempted on all subjects < or =15 years of age. Spherical equivalent >0.50 D in the worse eye was considered as refractive error. Data on objective refraction under cycloplegia were analyzed for subjects < or =15 years and on subjective refraction were analyzed for subjects >15 years of age. Results: Data on refractive error were available for 2,321 (92.0%) subjects. In subjects < or =15 years of age, age-gender-adjusted prevalence of myopia was 4.44% (95% confidence interval [CI], 2.14%-6.75%), which was higher in those 10 to 15 years of age (odds ratio, 2.75; 95% CI, 1.25-6.02), of hyperopia 59.37% (95% CI, 44.65%-74.09%), and of astigmatism 6.93% (95% CI, 4.90%-8.97%). In subjects >15 years of age, age-gender-adjusted prevalence of myopia was 19.39% (95% CI, 16.54%-22.24%), of hyperopia 9.83% (95% CI, 6.21%-13.45%), and of astigmatism 12.94% (95% CI, 10.80%-15.07%). With multivariate analysis, myopia was significantly higher in subjects with Lens Opacity Classification System HI nuclear cataract grade > or =3.5 (odds ratio, 9.10; 95% CI, 5.15-16.09), and in subjects with education of class 11 or higher (odds ratio, 1.80; 95% CI, 1.18-2.74); hyperopia was significantly higher in subjects > or =30 years of age compared with those 16 to 29 years of age (odds ratio, 37.26; 95% CI, 11.84-117.19), in females (odds ratio, 1.86; 95% CI, 1.33-2.61), and in subjects belonging to middle and upper socioeconomic strata (odds ratio, 2.10; 95% CI, 1.09-4.03); and astigmatism was significantly higher in subjects > or =40 years of age (odds ratio, 3.00; 95% CI, 2.23-4.03) and in those with education of college level or higher (odds ratio, 1.73; 95% CI, 1.07-2.81).
Conclusions: These population-based data on distribution and demographic associations of refractive error could enable planning of eye-care services to reduce visual impairment caused by refractive error. If these data are extrapolated to the 255 million urban population of India, among those >15 years of age an estimated 30 million people would have myopia, 15.2 million hyperopia, and 4.1 million astigmatism not concurrent with myopia or hyperopia; in addition, based on refraction under cycloplegia, 4.4 million children would have myopia and 2.5 million astigmatism not concurrent with myopia or hyperopia [16].

Wensor et al., made a research work on Prevalence and risk factors of myopia in Victoria, Australia. Objective: To determine the prevalence and risk factors of myopia in urban and rural Victoria, Australia. Methods: The Visual Impairment Project is a population-based prevalence study of eye disease in which both urban and rural adult populations were examined. Refractive data on the participants were collected using logMAR visual acuity, corrective lens measurement, and subjective refraction. All refractive error data were converted into spherical equivalent and myopia was defined at 2 levels: worse than -0.5 diopters (D) and worse than -1.00 D. Results: A total of 3271 (83%) urban and 1473 (91%) rural residents were examined. The overall prevalence of myopia worse than -0.50 D in the population was 17% (95% confidence limit = 15.8%, 18.0%). Prevalence of myopia decreased from 24% in those aged 40 to 49 years to 12% in those aged 70 to 79 years, and then increased to 17% in people older than 80 years. The younger age groups also had higher usage of myopic corrective lenses throughout their lives than the older age groups, indicating an increased use of myopic corrective lenses in recent times. Myopia was found to be significantly higher in people with higher education levels (chi2 = 119.20, P < .001), in clerks and professionals (chi2 = 132.53, P < .001), in people born in south-east Asia (chi2 = 77.62, P < .001), and in people with higher degrees of nuclear opacity (chi2 = 55.26, P < .001). Conclusion: Myopia rates in the Visual Impairment Project generally decrease with age and use of myopic correction has increased in recent times. Myopia was significantly related to education level, occupation, country of birth, and nuclear opacity [17].
Zhao et al., conducted a study on *Refractive error study in children: results from Shunyi District, China*. Purpose: To assess the prevalence of refractive errors and vision impairment in school-age children in Shunyi District, northeast of Beijing, the Peoples Republic of China. Methods: Random selection of village-based clusters was used to identify a sample of children 5 to 15 years of age. Resident registration books were used to enumerate eligible children in the selected villages and identify their current school. Ophthalmic examinations were conducted in 132 schools on children from 29 clusters during May 1988 to July 1998, including visual acuity measurements, cycloplegic retinoscopy, cycloplegic autorefraction, ocular motility evaluation, and examination of the external eye, anterior segment, media, and fundus. Independent replicate measurements of all children with reduced vision and a sample of those with normal vision were done for quality assurance monitoring in three schools. Results: A total of 6,134 children from 4,338 households were enumerated, and 5,884 children (95.9%) were examined. The prevalence of uncorrected, presenting, and best visual acuity 0.5 (20/40) or worse in at least one eye was 12.8%, 10.9%, and 1.8%, respectively; 0.4% had best visual acuity 0.5 or worse in both eyes. Refractive error was the cause in 89.5% of the 1,236 eyes with reduced vision, amblyopia in 5%, other causes in 1.5%, with unexplained causes in the remaining 4%. Myopia $\leq 0.5$ diopter or less in either eye was essentially absent in 5-year-old children, but increased to 36.7% in males and 55.0% in females by age 15. Over this same age range, hyperopia 2 diopters or greater decreased from 8.8% in males and 19.6% in females to less than 2% in both. Females had a significantly higher risk of both myopia and hyperopia. Conclusions: Reduced vision because of myopia is an important public health problem in school-age children in Shunyi District. More than 9% of children could benefit from prescription glasses. Further studies are needed to determine whether the upward trend in the prevalence of myopia continues far beyond age 15 and whether the development of myopia is changing for more recent birth cohorts [18].

Maul et al., conducted a study on *Refractive Error Study in Children: results from La Florida, Chile*. Purpose: To assess the prevalence of refractive errors and vision impairment in school-age children in a suburban area (La Florida) of
Santiago, Chile. Methods: Random selection of geographically defined clusters was used to identify a representative sample of children 5 to 15 years of age. Children in the 26 selected clusters were enumerated through a door-to-door survey and invited to report to a community health clinic for examination. Visual acuity measurements, cycloplegic retinoscopy, cycloplegic autorefraction, ocular motility evaluation, and examination of the external eye, anterior segment, media, and fundus were done from April through August 1998. Independent replicate examinations of all children with reduced vision and a sample of those with normal vision were done for quality assurance monitoring in six clusters. Results: A total of 6,998 children from 3,830 households were enumerated, and 5,303 children (75.8%) were examined. The prevalence of uncorrected, presenting, and best visual acuity 0.50 (20/40) or worse in at least one eye was 15.8%, 14.7%, and 7.4%, respectively; 3.3% had best visual acuity 0.50 or worse in both eyes. Refractive error was the cause in 56.3% of the 1,285 eyes with reduced vision, amblyopia in 6.5%, other causes in 4.3%, with unexplained causes in the remaining 32.9%. Myopia - 0.50 diopter or less in either eye was present in 3.4% of 5-year-old children, increasing to 19.4% in males and 14.7% in females by age 15. Over this same age range, hyperopia 2.00 diopters or greater decreased from 22.7% to 7.1% in males and from 26.3% to 8.9% in females. Females had a significantly higher risk of hyperopia than males. Conclusions: Refractive error, associated primarily with myopia, is a major cause of reduced vision in school-age children in La Florida. More than 7% of children could benefit from the provision of proper spectacles. Efforts are needed to make existing programs that provide free spectacles for school children more effective. Further studies are needed to determine whether the upward trend in myopia continues far beyond 15 years of age [19].

Mavracanas et al., conducted a study on Prevalence of myopia in a sample of Greek students. Purpose: An epidemiological study, concerning the prevalence of myopia among the student population (15-18 years old) of Northern Greece, was carried out. Methods: Specific questionnaires were used in order to collect data on the refractive condition of students. Results: Myopia prevalence was 36.8% and was found to be more common in females (46.0%) than in males.
The prevalence increased in students with myopic parents and myopic siblings. It was also found that myopia correlates strongly with near work and school performance. Conclusion: The study results suggest that myopia is a rather common refractive error in Greek students. Findings also indicate that myopia is probably hereditary and correlates with educational level, intelligence and excessive near work [20].

Kawuma and Mayeku conducted a study on A survey of the prevalence of refractive errors among children in lower primary schools in Kampala district Background: Refractive errors are a known cause of visual impairment and may cause blindness worldwide. In children, refractive errors may prevent those afflicted from progressing with their studies. In Uganda, like in many developing countries, there is no established vision-screening programme for children on commencement of school, such that those with early onset of such errors will have many years of poor vision. Over all, there is limited information on refractive errors among children in Africa. Objective: To determine the prevalence of refractive errors among school children attending lower primary in Kampala district; the frequency of the various types of refractive errors, and their relationship to sexuality and ethnicity. Design: A cross-sectional descriptive study. Setting: Kampala district, Uganda. Patients: A total of 623 children aged between 6 and 9 years had a visual acuity testing done at school using the same protocol; of these 301 (48.3%) were boys and 322 (51.7%) girls. Results: Seventy-three children had a significant refractive error of ±0.50 or worse in one or both eyes, giving a prevalence of 11.6% and the commonest single refractive error was astigmatism which accounted for 52% of all errors. This was followed by hypermetropia, and myopia was the least common. Conclusion: Significant refractive errors occur among primary school children aged 6 to 9 years at a prevalence of approximately 12%. Therefore, there is a need to have regular and simple vision testing in primary school children at least at the commencement of school so as to detect those who may suffer from these disabilities. Methods: Two cross-sectional samples of age- and ethnicity-matched primary school children participated: 124 from the Sydney Myopia Study and 628 from the Singapore Cohort Study on the Risk Factors for Myopia. Cyclopelagic auto
refraction was used to determine myopia prevalence (spherical equivalent – 0.5 diopter). Lifestyle activities were ascertained by questionnaire [21].

Murthy et al., conducted a study on "Refractive Error in Children in an Urban Population in New Delhi" Purpose. To assess the prevalence of refractive error and related visual impairment in school-aged children in an urban population in New Delhi, India. Methods: Random selection of geographically defined clusters was used to identify a sample of children 5 to 15 years of age. From December 2000 through March 2001, children in 22 selected clusters were enumerated through a door-to-door survey and examined at a local facility. The examination included visual acuity measurements, ocular motility evaluation, retinoscopy and autorefration under cycloplegia, and examination of the anterior segment, media, and fundus. Myopia was defined as spherical equivalent refractive error of at least -0.50 D and hyperopia as +2.00D or more. Children with reduced vision and a sample of those with normal vision underwent independent replicate examinations for quality assurance in four of the clusters. Results: A total of 7008 children from 3426 households were enumerated, and 6447 (92.0%) examined. The prevalence of uncorrected, baseline (presenting), and best corrected visual acuity of 20/40 or worse in the better eye was 6.4%, 4.9%, and 0.81%, respectively. Refractive error was the cause in 81.7% of eyes with vision impairment, amblyopia in 4.4%, retinal disorders in 4.7%, other causes in 3.3%, and unexplained causes in the remaining 5.9%. There was an age-related shift in refractive error from hyperopia in young children (15.6% in 5-year-olds) toward myopia in older children (10.8% in 15-year-olds). Overall, hyperopia was present in 7.7% of children and myopia in 7.4%. Hyperopia was associated with female gender. Myopia was more common in children of fathers with higher levels of education. Conclusions: Reduced vision because of uncorrected refractive error is a major public health problem in urban school-aged children in India. Cost-effective strategies are needed to eliminate this easily treated cause of vision impairment [22].

Dandona et al., made a research work on "Refractive Error in Children in a Rural Population in India." Purpose: To assess the prevalence of refractive error and related visual impairment in school-aged children in the rural population of the
Mahabubnagar district in the southern Indian state of Andhra Pradesh. Methods: Random selection of village-based clusters was used to identify a sample of children 7 to 15 years of age. From April 2000 through February 2001, children in the 25 selected clusters were enumerated in a door-to-door survey and examined at a rural eye center in the district. The examination included visual acuity measurements, ocular motility evaluation, retinoscopy and auto refraction under cycloplegia, and examination of the anterior segment, media, and fundus. Myopia was defined as spherical equivalent refractive error of at least -0.50 D and hyperopia as +2.00 D or more. Children with reduced vision and a sample of those with normal vision underwent independent replicate examinations for quality assurance in seven clusters. Results: A total of 4414 children from 4876 households was enumerated, and 4074 (92.3%) were examined. The prevalence of uncorrected, baseline (presenting), and best corrected visual acuity of 20/40 or worse in the better eye was 2.7%, 2.6%, and 0.78%, respectively. Refractive error was the cause in 61% of eyes with vision impairment, amblyopia in 12%, other causes in 15%, and unexplained causes in the remaining 13%. A gradual shift toward less-positive values of refractive error occurred with increasing age in both boys and girls. Myopia in one or both eyes was present in 4.1% of the children. Myopia risk was associated with female gender and having a father with a higher level of schooling. Higher risk of myopia in children of older age was of borderline statistical significance (P = 0.069). Hyperopia in at least one eye was present in 0.8% of children, with no significant predictors. Conclusions: Refractive error was the main cause of visual impairment in children aged between 7 and 15 years in rural India. There was a benefit of spectacles in 70% of those who had visual acuity of 20/40 or worse in the better eye at baseline examination. Because visual impairment can have a significant impact on a child’s life in terms of education and development, it is important that effective strategies be developed to eliminate this easily treated cause of visual impairment [23].

Fan et al., conducted a research on Prevalence, Incidence, and Progression of Myopia of School Children in Hong Kong Purpose. To determine the prevalence, incidence, and progression of myopia of Chinese children in Hong
Kong. Methods: A cross-sectional survey was initially conducted. A longitudinal follow-up study was then conducted 12 months later. Results: A total of 7560 children of mean age 9.33 (95% confidence interval [CI] = 9.11–9.45; range, 5–16) participated in the study. Mean spherical equivalent refraction (SER) was -0.33 D (SD = 11.56; range, -13.13 to +14.25 D). Myopia (SER ≤ -0.50 D) was the most common refractive error and was found in 36.71% ± 2.87% (SD) of children. Prevalence of myopia correlated positively with older age. Children aged 11 years were almost 15 times more likely to have myopia than were children younger than 7 years (Odds ratio [OR] = 14.81; 95% CI = 14.17–15.48). Incidence of myopia was 144.1 ± 2.31 (SD) per 1000 primary school children per annum. Increasing age was correlated with increased incidence of myopia, with highest risk in children ages 11 years (OR = 2.27; 95% CI = 2.11–2.44). The average annual change in SER for children with myopia (SER ≤ -0.50 D) was -0.63 D (SD = 3.44) compared with -0.29 D (SD = 2.96) for those who were not myopic at the beginning of the study (P < 0.001). Conclusions: The results show that the prevalence and progression of myopia in Hong Kong children was much higher than those previously reported in Western countries. The long-term socioeconomic impact of these findings warrants further studies [24].

Mingguang He et al., conducted a study on Refractive Error and Visual Impairment in Urban Children in Southern China Purpose. To assess the prevalence of refractive error and visual impairment in school-age children in a metropolitan area of southern China. Methods: Random selection of geographically defined clusters was used to identify children 5 to 15 years of age in Guangzhou. Children in 22 clusters were enumerated through a door-to-door survey and examined in 71 schools and 19 community facilities from October 2002 to January 2003. The examination included visual acuity measurements, ocular motility evaluation, retinoscopy, and auto refraction under cycloplegia and examination of the external eye, anterior segment, media, and fundus. Results: A total of 5053 children living in 4814 households were enumerated, and 4364 (86.4%) were examined. The prevalence of uncorrected, presenting, and best-corrected visual acuity 20/40 or worse in the better eye was 22.3%, 10.3%, and 0.62%, respectively. Refractive error
was the cause in 94.9% of 2335 eyes with reduced vision, amblyopia in 1.9%, other causes in 0.4%, and unexplained causes in the remaining 2.8%. External and anterior segment abnormalities were seen in 1496 (34.3%) children, mainly minor conjunctival abnormalities. Media and fundus abnormalities were observed in 32 (0.73%) children. Myopia (spherical equivalent of at least -0.50 D in either eye) measured with retinoscopy affected 73.1% of children 15 years of age, 78.4% with autorefraction. The prevalence of myopia was 3.3% in 5-year-olds with retinoscopy and 5.7% with autorefraction. Females had a significantly higher risk of myopia. Hyperopia (+2.00 D or more) measured with retinoscopy was present in 16.7% of 5-year-olds, 17.0% with autorefraction. The prevalence of hyperopia was below 1% in 15-year-olds, with both methods. Astigmatism (cylinder of ≥0.75 D) was present in 33.6% of children with retinoscopy and in 42.7% with autorefraction.

Conclusions: The prevalence of reduced vision because of myopia is high in school-age children living in metropolitan Guangzhou, representing an important public health problem. One third of these children do not have the necessary corrective spectacles. Effective strategies are needed to eliminate this easily treated cause of significant visual impairment [25].
compared between countries: for presenting visual acuity of less than 6/18, the uncertainties given were between 20% and 25%. These uncertainties in turn affect the estimates for the age group 16–39 years, which are based on the results for the age group 5–15 years. The uncertainties reported in the RACSS studies are between 15% and 25% for the prevalence of visual acuity of less than 6/18; other studies reported uncertainties from 15% to more than 20%. In all the studies, the uncertainties become higher for the prevalence of visual impairment of less than 3/60. Uncorrected refractive errors are a major cause of blindness and low vision: it is estimated that 8 million people are blind and 145 million have low vision because of lack of adequate refractive correction. The uncertainties associated with the data and the extrapolations can lead to overestimates as well as underestimates of these figures: if the uncertainties are estimated at 20%, the total of 153 million could vary from 123 million to 184 million. The estimate of visual impairment caused by uncorrected refractive errors presented in this paper confirms that the problem is of public health concern, as emphasized previously. This finding is significant considering that refractive errors could be easily diagnosed and that spectacle correction is among the most cost-effective interventions in eye care [26].

Robaei et al., Made a research work on Visual acuity and the causes of visual loss in a population-based sample of 6-year-old Australian children. Purpose: To describe the distribution of visual acuity and causes of visual loss in a representative sample of Australian schoolchildren. Design: Population-based cross-sectional study. Participants: One thousand seven hundred thirty-eight predominantly 6-year old children examined during 2003 to 2004. Methods: Logarithm of the minimum angle of resolution (logMAR) visual acuity was measured in both eyes before and after pinhole correction and with spectacles if worn. Cycloplegic autorefraction (cyclopentolate) and detailed dilated fundus examination were performed. Main Outcome Measures: Visual impairment was defined as any (visual acuity <20/40; <40 letters) or severe (visual acuity < or =20/200; 0-5 letters) for both better and worse eyes. Myopia was defined as spherical equivalent (SE) refraction < or =-0.50 diopters (D), and hyperopia as SE refraction > or =+2.0 D, deemed significant when > or =+3.0 D. Astigmatism was
defined as cylinder > or = 1.0 D and anisometropia as SE refraction difference between eyes at least 1.0 D. Amblyopia was defined as corrected visual acuity <0.3 logMAR units (<20/40; <40 letters) in the affected eye not attributable to any underlying structural abnormality of the eye or visual pathway, together with a 2-logMAR line difference between the eyes and presence of an amblyogenic risk factor. Results: The mean visual acuity of this sample was 20/25 (49.3 letters). Uncorrected visual impairment was found in the better eye of 23 children (1.3%) and in the worse eye of 71 children (4.1%). The prevalence was higher in girls than boys and among children of lower socioeconomic status. Refractive error was the most frequent cause, accounting for 69.0%, followed by amblyopia (22.5%). Astigmatism was the principle refractive error causing visual impairment and was frequently uncorrected. Presenting visual impairment (using current glasses if worn) was found in the better and worse eyes of 15 children (0.9%) and 54 children (2.8%), respectively. This was mainly due to under corrected or uncorrected refractive error. Conclusions: This study has documented a relatively low prevalence of visual impairment in a population of Australian children. Uncorrected astigmatism and amblyopia were the most frequent causes [27].

Das et al., Made a research work on A study on refractive errors among school children in Kolkata. Childhood visual impairment due to refractive errors is a significant problem in school children and has a considerable impact on public health. To assess the magnitude of the problem the present study was undertaken among the school children aged 5 to 10 years in Kolkata. Detailed ophthalmological examination was carried out in the schools as well as in the Regional Institute of Ophthalmology, Kolkata. Among 2317 students examined, 582 (25.11%) were suffering from refractive errors, myopia being the commonest (n = 325; 14.02%). Astigmatism affected 91 children (3.93%). There is an increase of prevalence of refractive errors with increase of age, but it is not statistically significant (p > 0.05). There is also no significant difference of refractive errors between boys and girls [28].

He et al., conducted a study on Refractive error and visual impairment in school children in rural southern China Purpose: To assess the prevalence of
refractive error and visual impairment in school children in a rural area of southern China. Design: Prospective cross-sectional survey. Participants: Two thousand four hundred children from junior high schools in Yangxi County. Methods: Random selection of classes from the 3 junior high school grade levels was used to identify the study sample. Children from 36 classes in 13 schools were examined in April 2005. The examination included visual acuity (VA) testing; ocular motility evaluation; cycloplegic autorefraction; and examination of the external eye, anterior segment, media, and fundus. Main Outcome Measures: Distance VA and cycloplegic refraction. Results: Among 2515 enumerated children, 2454 (97.6%) were examined. The study population consisted of the 2400 children between 13 and 17 years old. Prevalence of uncorrected, presenting, and best-corrected VA ≤ 20/40 in the better eye were 27.0%, 16.6%, and 0.46%, respectively. Sixty percent of those who could achieve acuity > or = 20/32 in at least one eye with best correction were without the necessary spectacles. Refractive error was the cause in 97.1% of eyes with reduced vision; amblyopia, 0.81%; other causes, 0.67%; and unexplained causes, 1.4%. Myopia (spherical equivalent, -0.50 diopters [D] or more in either eye) affected 36.8% of 13-year-olds, increasing to 53.9% of 17-year-olds. Myopia was associated with higher grade level, female gender, schooling in the county urban center, and higher parental education. Hyperopia (+2.00 D or more) affected approximately 1.0% in all age groups. Astigmatism (> or =0.75 D) was present in 25.3% of all children. Conclusions: Reduced vision because of uncorrected myopia is a public health problem among school-age children in rural China. Effective VA screening strategies are needed to eliminate this easily treated cause of visual impairment [29].

Hashim et al., conducted a study on Prevalence of refractive error in malay primary school children in suburban area of Kota Bharu, Kelantan, Malaysia. Introduction: Refractive error remains one of the primary causes of visual impairment in children worldwide, and the prevalence of refractive error varies widely. The objective of this study was to determine the prevalence of refractive error and study the possible associated factors inducing refractive error among primary school children of Malay ethnicity in the suburban area of Kota Bharu,
Kelantan, Malaysia. Materials and Methods: A school-based cross-sectional study was performed from January to July 2006 by random selection on Standard 1 to Standard 6 students of 10 primary schools in the Kota Bharu district. Visual acuity assessment was measured using logMAR ETDRS chart. Positive predictive value of uncorrected visual acuity equal or worse than 20/40, was used as a cut-off point for further evaluation by automated refraction and retinoscopic refraction. Results: A total of 840 students were enumerated but only 705 were examined. The prevalence of uncorrected visual impairment was seen in 54 (7.7%) children. The main cause of the uncorrected visual impairment was refractive error which contributed to 90.7% of the total, and with 7.0% prevalence for the studied population. Myopia is the most common type of refractive error among children aged 6 to 12 years with prevalence of 5.4%, followed by hyperopia at 1.0% and astigmatism at 0.6%. A significant positive correlation was noted between myopia development with increasing age (P <0.005), more hours spent on reading books (P <0.005) and background history of siblings with glasses (P <0.005) and whose parents are of higher educational level (P <0.005). Malays in suburban Kelantan (5.4%) have the lowest prevalence of myopia compared with Malays in the metropolitan cities of Kuala Lumpur (9.2%) and Singapore (22.1%). Conclusion: The ethnicity-specific prevalence rate of myopia was the lowest among Malays in Kota Bharu, followed by Kuala Lumpur, and is the highest among Singaporean Malays. Better socio-economic factors could have contributed to higher myopia rates in the cities, since the genetic background of these ethnic Malays are similar [30].

Hussein and Ahmed made a research on Prevalence of Refractive Errors in School Children (12-17 Years) of Tafila City. Objective: To study the prevalence of refractive errors in school children (12-17 years) of Tafila city by age, sex, class and type. Study Design: Cross-sectional study in schools of Tafila city conducted from September 2004 to March 2005 for 1,647 school children which included 828 males and 819 females analysed by Chi square test, proportions. Results: 25.32% of the students were found to be having refractive errors. Of these 47% were females and 53% were males. The distribution of refractive errors was: Myopia - 63.5%, Hypermetropia 11.2% and astigmatism 20.4%. Conclusions: These
data support the assumption that vision screening of school children in developing countries could be useful in detecting correctable causes of decreased vision especially refractive errors and in minimizing long term visual disability [31].

**Maggie Fox and U.S. Researchers** reported as *Half of all Americans have some sort of vision problem, most of them myopia or astigmatism* This is far higher than previous estimates, the team at the National Eye Institute reported in the Archives of Ophthalmology. "Clinically important refractive error affects half of the U.S. population 20 years or older," wrote Susan Vitale and colleagues at the institute, one of the U.S. government's National Institutes of Health (NIH). They analyzed data from the National Health and Nutrition Examination Survey on 12,000 people aged 20 and older between 1999 and 2004. More than 33 percent were nearsighted and 36 percent had astigmatism, which causes fuzzy vision, the team reported. Another 3.6 percent were farsighted, meaning they can see at a distance but not up close. "Our estimated prevalence of myopia was higher than the 25 percent reported in previous U.S. studies and similar (in persons under 40 years) to that of ethnic Chinese persons in Singapore," they wrote. "The direct annual cost of refractive correction for distance visual impairment is estimated to be between $3.8 and $7.2 billion for persons 12 years and older. The study matches findings in other countries that have shown about half the population have a so-called refractive vision problem, usually requiring the use of glasses, contact lenses or corrective surgery. The causes of these three eye conditions are unclear but there is a genetic component. Most studies discount the widely held belief that myopia is caused by too much reading or close work as a child [32].

**Sapkot et al.,** conducted a study on *The Prevalence of Visual Impairment in School Children of Upper-Middle Socioeconomic Status in Kathmandu* Purpose: Assess visual impairment in school children of upper-middle socioeconomic status in Kathmandu for comparison with rural Jhapa District. *Methods:* Random selection of classes from secondary private schools in Kathmandu was used to identify the study sample. Children in 130 classes at 43 schools were enumerated using school records and examined between January–May 2006. Examinations included visual acuity testing, ocular motility evaluation, cycloplegic
refraction, and examination of the external eye, anterior segment, media, and fundus. The principal cause was determined for eyes with uncorrected visual acuity \( \leq 20/40 \).

**Results:** A total of 4,501 children in grades 5–9 were enumerated; 4,282 (95.1%) were examined. The prevalence of uncorrected, presenting, and best-corrected visual impairment (\( \leq 20/40 \)) in the better eye was 18.6%, 9.1%, and 0.86%, respectively. Refractive error was a cause in 93.3% of children with uncorrected visual impairment, amblyopia 1.8%, retinal disorders 1.3%, other causes 0.3%, and unexplained causes 4.4%. Among children correctable in at least one eye, 46.3% presented without the necessary spectacles. Visual impairment with myopia (\(-0.50\) diopters) ranged from 10.9% in 10 year-olds to 27.3% in 15 year-olds, compared to 0.5%–3.0% in rural Jhapa District. Myopic visual impairment was associated with grade level, female gender, parental education, parental spectacle usage, and Mongol ethnicity. Conclusions: Visual impairment with myopia among upper-middle socioeconomic school children in Kathmandu is higher than that in rural Nepal, and a public health problem because nearly half are without corrective spectacles. Effective strategies are needed to eliminate this easily treatable cause of visual impairment [33].

**Kingo and Ndawi** conducted a study on *Prevalence and causes of low vision among schoolchildren in Kibaha District, Tanzania*. Low vision is a major cause of morbidity and has profound effects on the quality of life for many people as it inhibits/reduces mobility and economical well being of the affected individuals and their families. The objective of the study was to determine the magnitude and causes of low vision among primary school children in Kibaha district in Tanzania. Primary schoolchildren were recruited for the study. The inclusion criterion was individual child with low vision of less than 6/18. Visual examination was used for screening the children to identify those with vision less than 6/18. Snellen's chart was used to measure visual acuity of the children with low vision. A total of 400 (6-17 years) schoolchildren were screened. Thirty-eight (9.5%) had low vision. The prevalence of low vision was statistically higher (N=33; 87%) among 12-17 years old than among 6-11 years old (13%) \((P<0.05)\). Of the 38 children with low vision, the prevalence in females (68%) was statistically higher than in males (32%).
were multiple causes of low vision among affected children. Congenital anomalies accounted for the largest proportion (65%) of the causes of low vision. In twenty-three (60%) of the children (12-17 years), low vision was due to retinopathies. Fifty-five percent of the children with refractive error were aged between 6-11 years. Among the cases, 8 (54%) had low vision caused by uncorrected refractive errors while the rest (46%) were due to other types of refractive errors. Two children had corneal scars; one with central and another with whole corneal scar. In conclusion, prevalence of low vision among schoolchildren in Kibaha district is high and increases with age. The main causes are congenital anomalies. There is need for an early detection of the possible causes and appropriate treatment to reduce the condition among schoolchildren. It is therefore important that the District Council Health Management Team (DCHMT) establishes school eye screening program for early detection and treatment. It is equally important to strengthen advocacy program targeting schoolchildren, teachers and caregivers on the public health importance of low vision [34].

Khalaj et al., made a research work on the prevalence of refractive error and related visual impairment in school children between 7-15 years in the city of Qazvin Northeastern Iran. Cross-sectional study performed in schools of Qazvin city conducted from October 2002 to September 2008 for 5913 school children. Refractometry was performed on both eyes randomly selected students and corrected visual acuity ≥ 0.5 [in either eye], were included in the study. The examination included visual acuity measurements, ocular motility evaluation, retinoscopy and autorefraction under cycloplegy, and examination of the anterior segment, media and fundus. Myopia was defined as spherical equivalent refractive error of at least -0.5 D and hyperopia as +2.00 D or more. The data were evaluated by the SPSS. Of 5903 students 7 to 15 years old, 59% were females and 41% were males. The distribution of refractive errors was: Myopia, Hypermetropia, astigmatism and Amblyopia were 65%, 12.46%, 16.1% and 6.37% respectively. Myopia was more prevalent in women [60%] than in men [40%]. [P < .005], and in hyperopia was 56.74% in women and 43.26% [P < .005] in men. There was an age related shift in refractive error from hyperopia in younger children [14% in 7 year
Toward myopia in older [55% in 15 year olds]. Refractive error was the main cause of visual impairment in children aged between 7 and 15 years in Qazvin-Iran. An increased prevalence of refractive error especially myopia was found in this study. Amblyopia and reduced vision because of uncorrected refractive error is a major public health problem in Qazvin school-aged children in Iran [35].

Sharma et al., made a research work on Magnitude of Refractive Errors among school children in a rural block of Haryana. Objectives: To study the prevalence of Refractive Errors in school children (6-15 years) and their association with age and sex. Study Design: Cross-sectional. Setting: Govt. Senior Secondary Schools of Block Lakhanmajra. Participants: 1265 school children (6-15 years). Methodology: Out of 16 Govt. Senior Secondary Schools, 4 were randomly chosen. Students aged 6-15 years studying in class 1 to 10 were included in the study. Visual Acuity (VA) test was performed using Snellen's E chart. The finding of clinical examination was recorded on a pretested Performa and were analyzed. Statistical Analysis: percentages, Chi-square test and Fisher's exact test. RESULT: Out of 1265, 172 children (13.6%) were found to have defective vision (≤6/9). Myopia affected only one eye in 22 (1.74%) students while both eyes were affected in 131 (10.36%) students. Hyperopia affected one eye only in 2 (0.16%) students while in 17 (1.34%) students both eyes were affected. The prevalence of myopia, hyperopia & astigmatism was more in girls (23.7%) as compared to boys (12.2%). The prevalence of myopia & astigmatism was more in higher age groups and the prevalence of hyperopia was more in lower age groups. Conclusion: Refractive errors can have a long term impact on the learning abilities of school children and visual screening by trained teachers can play an important role in early detection [36].

O’Donoghue et al., made a research work on Refractive error and visual impairment in school children in Northern Ireland Aims: To describe the prevalence of refractive error (myopia and hyperopia) and visual impairment in a representative sample of white school children. Methods: The Northern Ireland Childhood Errors of Refraction study, a population-based cross-sectional study, examined 661 white 12–13-year-old and 392 white 6–7-year-old children between
2006 and 2008. Procedures included assessment of monocular logarithm of the minimum angle of resolution (logMAR), visual acuity (unaided and presenting) and binocular open-field cycloplegic (1% cyclopentolate) autorefraction. Myopia was defined as \( \geq -0.50 \)DS or more myopic spherical equivalent refraction (SER) in either eye, hyperopia as \( \geq +2.00 \)DS SER in either eye if not previously classified as myopic. Visual impairment was defined as \( >0.30 \) logMAR units (equivalent to 6/12). Results: Levels of myopia were 2.8% (95% CI 1.3% to 4.3%) in younger and 17.7% (95% CI 13.2% to 22.2%) in older children: corresponding levels of hyperopia were 26% (95% CI 20% to 33%) and 14.7% (95% CI 9.9% to 19.4%). The prevalence of presenting visual impairment in the better eye was 3.6% in 12–13-year-old children compared with 1.5% in 6–7-year-old children. Almost one in four children fails to bring their spectacles to school. Conclusions: This study is the first to provide robust population-based data on the prevalence of refractive error and visual impairment in Northern Irish school children. Strategies to improve compliance with spectacle wear are required [37].

O’Donoghue et al., conducted a study on Sampling and measurement methods for a study of childhood refractive error in a UK population. Background: There is a paucity of data describing the prevalence of childhood refractive error in the United Kingdom. The Northern Ireland Childhood Errors of Refraction study, along with its sister study the Aston Eye Study, are the first population-based surveys of children using both random cluster sampling and cycloplegic autorefraction to quantify levels of refractive error in the United Kingdom. Methods: Children aged 6–7 years and 12–13 years were recruited from a stratified random sample of primary and post-primary schools, representative of the population of Northern Ireland as a whole. Measurements included assessment of visual acuity, oculomotor balance, ocular biometry and cycloplegic binocular open-field autorefraction. Questionnaires were used to identify putative risk factors for refractive error. Results: 399 (57%) of 6–7 years and 669 (60%) of 12–13 years participated. School participation rates did not vary statistically significantly with the size of the school, whether the school is urban or rural, or whether it is in a deprived/non-deprived area. The gender balance, ethnicity and type of schooling of
participants are reflective of the Northern Ireland population. Conclusions: The study design, sample size and methodology will ensure accurate measures of the prevalence of refractive errors in the target population and will facilitate comparisons with other population-based refractive data [38].

Haseeb Alam et al., made a critical research work on Prevalence of refractive error in school children of Karachi. Objective: To find out the prevalence of refractive error and the eye morbidity in the school children and the associated factors. Methods: One thousand students were selected from different schools of Karachi adopting two stage sampling technique. List of schools was obtained from Board of Secondary Education and 20 schools were randomly selected from the list in the five districts of Karachi during that period. Fifty students from each school were then selected adopting simple random technique. Results: A total of 1000 children from 20 schools were selected. However 940 were examined. The prevalence of refractive error was 8.9%. Mean age of the students was 9.49±2.5. Dominant ethnic group was Urdu speaking. Only 10.9% children were ever checked for their ophthalmic examination. Refractive error was associated with female sex but no association was found with class, age, ethnicity, parental education and other risk factors. About 1% students were color blind. Lack of association with increasing class may be due to poor educational training at Public sector schools. Conclusion: An increased prevalence of refractive error was found in this study. There is a need of periodical eye examination, preferably while entering and leaving the school [39].

Lian-Hong Pi et al., conducted a study on Refractive Status and Prevalence of Refractive Errors in Suburban School-age Children. Objective: This study investigated the distribution pattern of refractive status and prevalence of refractive errors in school-age children in Western China to determine the possible environmental factors. Methods: A random sampling strategy in geographically defined clusters was used to identify children aged 6-15 years in Yongchuan, a socio-economically representative area in Western China. We carried out a door-to-door survey and actual eye examinations, including visual acuity measurements, stereopsis examination, anterior segment and eyeball movements, fundus
examinations, and cycloplegic retinoscopy with 1% cyclopentolate. Results: A total of 3469 children living in 2552 households were selected, and 3070 were examined. The distributions of refractive status were positively-skewed for 6-8-year-olds, and negatively-skewed for 9-12 and 13-15-year-olds. The prevalence of hyperopia (≥+2.00 D spherical equivalent [SE]), myopia (≤-0.50 D SE), and astigmatism (≥1.00 diopter of cylinder [DC]) were 3.26%, 13.75%, and 3.75%, respectively. As children's ages increased, the prevalence rate of hyperopia decreased (P<0.001) and that of myopia increased significantly (P<0.001). Children in academically challenging schools had a higher risk of myopia (P<0.001) and astigmatism (≥1.00DC, P =0.04) than those in regular schools. Conclusion: The distribution of refractive status changes gradually from positively-skewed to negatively-skewed distributions as age increases, with 9-year-old being the critical age for the changes. Environmental factors and study intensity influence the occurrence and development of myopia [40].

Ovenseri-Ogbomo and Omuemu made a research work on Prevalence of refractive error among school children in the Cape Coast Municipality, Ghana. Uncorrected refractive errors continue to remain a public health problem among different population groups. Among school children, it has a considerable impact on learning and academic achievement especially in under-served and under-resourced communities. There is a dearth of information about the magnitude of the problem in Ghana. A school based cross-sectional study was carried out to estimate the prevalence and distribution of refractive error among school children in the Cape Coast Municipality of Central Region of Ghana. A total of 1103 school children were enumerated out of which 961 underwent a full eye examination. The children were aged between five and 19 years (mean = 10.5 ± 3.4 years, 95% confidence interval [CI]: 10.3–10.7). Cycloplegic refraction was performed on each child who failed the reading test. Hyperopia was defined as spherical power of ≥+2.00 diopters sphere (DS), myopia as ≤-0.50 D and astigmatism as a cylindrical power of ≤-0.50 D. Of the children examined, only 0.6% had previously had an eye examination. The prevalence of low vision and blindness in the study population was 0.9% (95% CI: 0.881–0.919) and 0.1% (95% CI: 0.081–0.119) respectively. 25.6% (95%
(95% CI: 22.84–28.37) of the children examined had refractive errors. This comprises of 44 (4.6%; 95% CI: 3.3–5.9) hyperopia, 66 (6.9%; 95% CI: 5.3–8.5) myopia and 135 (14.1%; 95% CI: 11.9–16.3) astigmatism of the 957 children examined. The study concludes that uncorrected refractive error is a common cause of visual impairment among school children in the municipality. A low uptake of eye care is also noted in the study. The study therefore recommends the education authority, in collaboration with the District Health Directorate, institutes appropriate measures to ensure compulsory eye examination for school children in the Cape Coast Municipality [41].

Sonam Sethi and Kartha conducted a study on Prevalence of Refractive Errors in School Children (12-17 Years) of Ahmedabad City Research Question: What is the prevalence of Refractive Errors in school children (12-17 years) of Ahmedabad City? Objective: To study the prevalence of refractive errors in school children (12-17 years) of Ahmedabad city by age, sex, class and type. Study Design: Cross-sectional. Setting: Schools of Ahmedabad city. Participants: School children aged 12-17 years studying in 7th to 12th class. Study Period: September 1997 to March 1998. Sample Size: 1,647 school children which included 828 males and 819 females. Study Variables: Refractive errors by age, sex, class and type. Statistical Analysis: Chi square test, proportions. Results: 25.32% of the students were found to be having refractive errors. Of these 47% were females and 53% were males. The distribution of refractive errors was: Myopia - 63.5%, Hypermetropia 11.2% and astigmatism 20.4%. School children in developing countries could be useful in detecting correctable causes of decreased vision especially refractive errors and in minimizing long term visual disability [42].

Mohammad and Mohammad Fareed Refractive Error, Profile in school age children. Objective: To know the profile of refractive errors in school age children in DHQ Hospital Karak and group of teaching Hospitals Bannu. Setting: DHQ Hospital Karak and group of Teaching hospitals Bannu. Period: Two years study from August 2007 to August 2009. Design: Descriptive study. Materials & Methods: A work up proforma was prepared for record of children. School age children with age range from 5 to 15 years who attended the eye OPD were
documented and informed consents were taken from children and their parents. They were screened for refractive errors with retinoscopy. In some children cycloplegic refraction was done. Fundoscopy was also done to exclude any lesion causing visual impairment in some children. Refractive errors was noted as spherical equivalent of myopia and hypermetropia in children who had both spherical and cylindrical error while in those children who had only cylindrical error were assigned as astigmatism. Children with any organic lesion in cornea lens and fundi were excluded from study. Results: Total 2680 school age children with age range from 5 to 15 years were examined out of which 1560(58.20%) were male and 1120(41.8%) were female. 1688(62.98%) children were emmetropic while 992(37.01%) had refractive error. Spherical equivalent of myopia was present in 541(54.53%) while that of hypermetropia in 360(36.29%) children. Astigmatism was present in 91(9.17%) children. Conclusions: Refractive error is a common ocular disorder affecting school age children. Myopia is more common followed by hypermetropia. Therefore routine careful visual check up in school age children should be carried out [43].

2.3 STUDIES RELATED TO REFRACTIVE ERROR AND EDUCATIONAL PERFORMANCE

Glewwe et al., presented a Research paper on The Impact of Eyeglasses on the Academic Performance of Primary School Students: Evidence from a Randomized Trial in Rural China. About 10% of primary school students in developing countries have poor vision, yet in virtually all of these countries very few children wear glasses. There has been almost no research on the impact of poor vision on school performance in developing countries, and simple OLS estimates are likely to be biased because students who study more often are likely to develop poor vision faster. This paper presents results from the first year of a randomized trial in Western China that began in the summer of 2004. The trial involves over 19,000 students in 165 schools in two counties of Gansu province. The schools were randomly divided (at the township level) into 103 schools that received eyeglasses (for students in grades 3-5) and 62 schools that served as controls. The results from the first year indicate that, after one year, provision of eyeglasses increased test
scores by 0.15 to 0.30 standard deviations (of the distribution of the test scores) [44].

Mohammed al-Jerafi et al., conducted a research on Poor eyesight dims students’ educational performance. There is no significant difference between the eyesight of males and females. About 46 percent of study participants were found to have normal eyesight. Some 54 percent suffered from some kind of eye problem, whether nearsightedness, farsightedness, or astigmatism. Astigmatism, an affliction of the eye where vision is blurred by an irregularly shaped cornea, affected 43 percent of the students, making it the commonest type of refractive error. This was followed by anisometropia, the condition in which the two eyes have an unequal refractive power, affecting 28 percent of students. Myopia, or nearsightedness, afflicted 19 percent; Hypermetropia afflicted 5 percent; and lesions on the eye afflicted 6 percent. The difference of distribution of refractive errors between males and females was insignificant. Students with poor vision who wore eyeglasses made up 11 percent, but 89 percent of people with poor vision did not have glasses. Possible reasons for this include the lack of social awareness about refractive errors. Furthermore, in Yemen many affected individuals find it a shame to wear eyeglasses, especially females. Absence of school health programs regarding the detection of vision problems is another contributing factor. The high costs of spectacles may be another reason more Yemenis don’t wear glasses. Myopic, hypermetropic and astigmatic students who wore eyeglasses scored better in tests than those who did not, and better than those with good vision. Therefore, correction of those refractive errors appeared to improve the reading ability of those students and, hence, their educational achievement. The effect of unequal eyesight (one eye sees well than the other) on educational performance was unclear. Myopic, hypermetropic and astigmatic students who were not wearing eyeglasses and sitting in the front scored better than their classmates (suffering the same problem and not wearing eyeglasses) who were sitting in the middle and in the back of the classroom. Again, it seems that the privilege of sitting in the front has a dramatic effect on educational performance. Similarly, astigmatic students (wearing eyeglasses) who were sitting in the front achieved better scores than those sitting in the middle, with
mean scores of 79.09 percent, 63 percent respectively. On the other hand, the mean scores of myopic students (wearing eyeglasses) who are sitting in the middle were 79 percent, better than of those in the front, who scored 72 percent. It seems that once myopia has been corrected, the position in class would not have negative effect on the educational performance. For students with unequal eyesight, position in class had no influence on their performance in school (68 percent for those in the front, 65 percent for those in the middle, and 71 percent for those in the back). These findings have not followed the trend of the other types of refractive errors, in which the eyeglasses wearing and the position in class have played an important role in changing the students’ score dramatically. The study, supervised by Khalid Saied, YahyaRaja’a and Ibrahim al-Gorafi, who are professors in the Faculty of Medicine and Health sciences, also found that the number of family members did not have an effect on the students’ achievement in school. Also, family income played a role in the educational attainment of the students. The mean scores of students belonging to families with income ranging from YR35,000 to YR50,000 were significantly higher than those belonging to families with income of less than YR35,000 (68 percent and 65 percent respectively). The lower standards of living may make parents pay less attention to their offspring’s affairs, and subsequently to their educational performance in school. The study also found a significant improvement in the mean scores of students who have fathers with higher education (69 percent) compared to the scores of those who have illiterate fathers (64 percent) or fathers who can read and write only (66 percent). The mean scores of students who have an illiterate mother, those having mothers who can read and write, those having mothers with secondary educational level and those having mothers with higher education were respectively 66 percent, 67 percent, 71 percent and 73 percent. So the more educated the mother, the better their children did in school [45].

Sheila et al., made a research work on Refractive error, IQ and reading ability: a longitudinal study from age 7 to 11 Children from a population sample whose cycloplegic refractive errors included myopia, pre-myopia and hypermetropia were compared on measures of IQ and reading with a group of children without
significance refractive errors. At age 11 both those with myopia and with pre-myopia had increased verbal and performance IQ, while those with hypermetropia had slightly reduced verbal and performance IQ, in comparison with the children without refractive errors. The differences in verbal IQ were not attributable simply to earlier differences, but the differences in performance IQ were attributable to earlier differences. No significant differences in reading scores were found at either age. It is concluded that differing abilities of myopic and other children at age 11 are not fully explained by differences in family background or in pre-existing ability [46].

Mathers et al., conducted a study on A review of the evidence on the effectiveness of children's vision screening. Screening programs enable health conditions to be identified so that effective interventions can be offered. The aim of this review was to determine: (1) the effectiveness of children's vision screening programs; (2) at what age children should attend vision screening; and (3) what form vision screening programs should take to be most effective. A literature review on the effectiveness of vision screening programs in children aged 0-16 years was undertaken. Eligible studies/reviews were identified through clinical databases, hand searches and consultation with expert reviewers. The methodological quality of papers was rated using National Health and Medical Research Council (NHMRC) guidelines. Screening of children 18 months to 5 years, and subsequent early treatment, led to improved visual outcomes. The benefit was primarily through treatment of amblyopia, with improved visual acuity of the amblyopic eye. However, the overall quality of the evidence was low. The implication of improved visual acuity (e.g. any potential impact on quality of life) was not considered. Without consideration of 'quality of life' values, such as loss of vision in one eye or possibility of future bilateral vision loss, the cost-effectiveness of screening is questionable. Screening and treating children with uncorrected refractive error can improve educational outcomes. Evidence suggested that screening occur in the preschool years. Orthoptists were favoured as screening personnel; however, nurses could achieve high sensitivity and specificity with appropriate training. Further research is required to assess the effectiveness of neonatal screening. Most studies
suggested that children's vision screening was beneficial, although program components varied widely (e.g. tests used, screening personnel and age at testing). Research is required to clearly define any improvements to quality of life and any related economic benefits resulting from childhood vision screening. The evidence could be used to guide optimization of existing program [47].

Wolfgang et al., made a research work on A survey of visual function in an Austrian population of school-age children with reading and writing difficulties. Background: To describe and compare visual function measures of two groups of school age children (6-14 years of age) attending a specialist eyecare practice in Austria; one group referred to the practice from educational assessment centres diagnosed with reading and writing difficulties and the other, a clinical age matched control group. Methods: Retrospective clinical data from one group of subjects with reading difficulties (n = 825) and a clinical control group of subjects (n = 328) were examined. Statistical analysis was performed to determine whether any differences existed between visual function measures from each group (refractive error, visual acuity, binocular status, accommodative function and reading speed and accuracy). Results: Statistical analysis using one way ANOVA demonstrated no differences between the two groups in terms of refractive error and the size or direction of heterophoria at distance (p > 0.05). Using predominately one way ANOVA and chi-square analyses, those subjects in the referred group were statistically more likely to have poorer distance visual acuity, an exophoric deviation at near, a lower amplitude of accommodation, reduced accommodative facility, reduced vergence facility, a reduced near point of convergence, a lower AC/A ratio and a slower reading speed than those in the clinical control group (p < 0.05). Conclusions: This study highlights the high proportions of visual function anomalies in a group of children with reading difficulties in an Austrian population. It confirms the importance of a full assessment of binocular visual status in order to detect and remedy these deficits in order to prevent the visual problems continuing to impact upon educational development [48].

Glewwe et al., Investigation made on A Better Vision for Development: Eyeglasses and Academic Performance in Rural Primary Schools in China Findings
of this research revealed that about 10% of primary school students in developing countries have poor vision, but very few of them wear glasses. Almost no research examines the impact of poor vision on school performance, and simple OLS estimates are likely to be biased because studying harder often adversely affect one’s vision. This paper presents results from a randomized trial in Western China that offered free eyeglasses to 1,528 rural primary school students. The results indicate that wearing eyeglasses for one year increased average test scores of students with poor vision by 0.15 to 0.22 standard deviations, equivalent to the learning acquired from an additional 0.33-0.50 years of schooling, and that the benefits are greater for under-performing students. A simple cost-benefit analysis suggests very high economic returns to wearing eyeglasses, raising the question of why such investments are not made by most families. We find that girls are more likely to refuse free eyeglasses, and that lack of parental awareness of vision problems, mothers’ education, and economic factors (expenditures per capita and price) significantly affect whether children wear eyeglasses in the absence of the intervention [49].

**Arvind Venkataraman** published an article in The Hindu (news paper), *An Eye Opener*. My Friend’s child was exceptional in reading, drawing and other indoor activities but showed no interest in outdoor activities. In school, her teacher complained about lack of interest in studies. My Puzzled friend took her to a doctor who referred him to an ophthalmologist. When she was examined, the girl had a high myopia (short sightedness). Now after vision correction with glasses she hardly stays at home, says the girl’s mother. This is a real eye opener, as many think that healthy children will have normal vision [50].

The author suggested some guidelines as

- Infants should have their first eye examination at six months of age. Additional exams at the age of 3 and 5-6 (just before they enter std. 1).
School children should get their eyes screened every two years if not vision correction is required. Children who need eyeglasses should be examined annually or as recommended by the doctor.

Premature babies need immediate eye examination followed by regular checkups to prevent early retinal problems. If untreated, they can end up with incurable blindness.

Children whose parents wear glasses and with a family history of squinting need regular follow-ups.

### 2.4 STUDIES RELATED TO NEAR WORK AND OUTDOOR ACTIVITIES

*Kinge et al.*, conducted a study on *The influence of near-work on development of myopia among university students*. A three-year longitudinal study among engineering students in Norway. Purpose: The aim of this study was to investigate the effect of near-work on development and progression of myopia among adults exposed to high educational demands. Methods: A three-year longitudinal refraction study was performed among 224 Norwegian engineering students (mean age 20.6 years, 117 females and 107 males) measuring their refraction at the beginning and the end of the period. The examinations included automated and clinical refraction in cycloplegia and a questionnaire regarding time spent on different kinds of near-work was filled in by the participants. A total of 192 students (100 females and 92 males) completed the study. Results: The mean refractive change of \(-0.51 +/- 0.49\) D (n=192) during the three-year period was statistically significant (p=0.0001). A significant relationship between refractive change towards myopia and time spent on reading scientific literature (p< or =0.001) and on practical near-work (p< or =0.05), respectively, was found. Also, a significant relationship between refractive change towards myopia and time spent at lectures was revealed (p< or =0.001). No relationship was found between refractive change and time spent at working with video display terminals (VDT) or watching television, respectively. Conclusions: The results indicate that intensive near-work
could initiate myopia or lead to its progression in young adults. The time spent on
near-work seems to play a significant role in that process [51].

Saw et al., conducted a study on Near-work activity, night-lights, and myopia in the Singapore-China study. Objective: To investigate the relationship among near-work activity, night-lights, and myopia in schoolchildren in Singapore and Xiamen, China. Methods: The refractive error and ocular dimensions of 957 Chinese schoolchildren aged 7 to 9 years in Singapore and Xiamen, China, were determined using cycloplegic autorefraction and A-scan ultrasound biometry. Information on near-work activity (number of books read per week, reading in hours per day) and night-light use before age 2 years was obtained. Results: The prevalence rate of myopia was 36.7% (95% confidence interval [CI], 33.0%-40.3%) in Singapore and 18.5% (95% CI, 14.0%-23.1%) in Xiamen, China. The crude odds ratio (OR) of higher myopia (at least -3.0 diopters) for children who read more than 2 books per week was 3.50 (95% CI, 2.15-5.70). In a multivariate logistic regression model, the OR of higher myopia for children who read more was 2.81 (95% CI, 1.69-4.69), adjusted for age, night-light use, parental myopia, and country, whereas there was no association between night-light use before age 2 years and higher myopia (OR, 1.54; 95% CI, 0.92-2.58), after controlling for age, books read per week, parental myopia, and country. Main Outcome Measures: The ORs of higher myopia for children who read more and children who are exposed to night-lights before age 2 years. Conclusions: Reading (number of books per week) may be associated with higher myopia in Chinese schoolchildren. However, night-light use does not seem to be related to higher myopia [52].

Saw et al., conducted a study on Near work in Early-Onset Myopia
Purpose: To determine the relationship of near work and myopia in young elementary school-age children in Singapore. Methods: A cross-sectional study of 1005 school children aged 7 to 9 years was conducted in two schools in Singapore. Cycloplegic autorefraction, keratometry and biometry measurements were performed. In addition, the parents completed a detailed questionnaire on near work activity (books read per week, reading in hours per day and diopter hours [addition of three times reading, two times computer use, and two times video games use in
hours per day]. Other risk factors, such as parental myopia, socioeconomic status, and light exposure history, were assessed. Results: In addition to socioeconomic factors, several near work indices were associated with myopia in these young children. The multivariate adjusted odds ratio of higher myopia (at least -3.0 D) for children who read more than two books per week was 3.05 (95% confidence interval [CI], 1.80–5.18). However, the odds ratios of higher myopia for children who read more than 2 hours per day or with more than 8 dioptr hours (1.50; 95% CI, 0.87–2.55 and 1.04; 95% CI, 0.61–1.78, respectively) were not significant, after controlling for several factors. Conclusions: Children aged 7 to 9 years with a greater current reading exposure were more likely to be myopic. This association of reading and myopia in a young age cohort was greater than the strength of the reading association generally found in older myopic subjects. Whether these results identify an association of early-onset myopia with near work activity or other potentially confounding factors is discussed [53].

Shimizu et al., conducted a study on Refractive errors and factors associated with myopia in an adult Japanese population. Purpose: To investigate the refractive status and factors associated with myopia by a population-based survey of Japanese adults. Methods: A total of 2168 subjects aged 40 to 79 years, randomly selected from a local community, were assessed in a cross-sectional study. The spherical equivalent of the refractive error was calculated and used in a multiple logistic regression analysis to evaluate the relationships between myopia and possible related factors. Results: The mean (+/- SD) of the spherical equivalent was -0.70 +/- 1.40 diopeters (D) in men, and -0.50 +/- 1.44 D in women. Based on +/- 0.5 D cutoff points, the prevalence of myopia, emmetropia, and hypermetropia were 45.7%, 40.8%, and 13.5% in men, and 38.3%, 43.1%, and 18.6% in women, respectively. A 10-year increase in age was associated with reduced risk of myopia [men: odds ratio (OR) = 0.53, 95% confidence interval (CI): 0.44-0.62; women: OR = 0.65, 95% CI: 0.54-0.78]. In men, myopia was significantly associated with higher education (high school: OR = 1.6, 95% CI: 1.1-2.3; college: OR = 2.0, 95% CI: 1.3-3.1) and management occupations (OR = 1.6, 95% CI: 1.0-2.4). For women, high income (OR = 1.5, 95% CI: 1.1-2.2), and clerical (OR = 1.5, 95% CI: 1.0-2.4)
and sales/service occupations (OR = 1.7, 95% CI: 1.1-2.6) were also associated with myopia. Conclusions: The prevalence of myopia in a Japanese population was similar to that in other Asian surveys but higher than in black or white populations. Our study confirmed a higher prevalence of myopia among younger vs. older populations, and a significant association with education levels and socioeconomic factors [54].

James Meikle came to a conclusion that Excessive computer use 'threat to eyesight' Watching a computer screen for nine or more hours a day might be linked to a progressive eye disease that can blind without treatment, researchers warned yesterday. The risk of developing glaucoma this way was highest for those with short sight, they said in a study which provided more bad news for male office workers and professionals. They were told by New York eye specialists last year that wearing a tightly knotted tie could make the condition more likely. The potential dangers of the booming use of new technology in the office and at home were outlined by researchers at the Toho University School of medicine in Tokyo, Japan, in the Journal of Epidemiology. They tested 10,000 workers with an average age of 43 as part of a general medical check-up as well as collecting their histories of computer use and eye disease. Just over 5% had visual field abnormalities and there appeared to be a significant link between these and heavy computer use among those with long or short sight. But detailed eye tests revealed that a third of these had suspected glaucoma, and this was more obvious in those with myopia. A link with short sight has already been established for glaucoma, a disease in which fluid cannot flow out of the eye because meshwork in the coloured part, the iris, has become blocked. Pressure then builds up, threatening damage to nerve fibres in the back of the eye and the optic nerve. But the added ingredient of heavy computer use, while long debated as a possible risk factor for short sight, has not been studied for glaucoma, according to David Wright, chief executive of the International Glaucoma Association (IGA), who said the researchers "have provided a fascinating study that needs to be followed up". About 2% of people over 40 develop glaucoma, which if diagnosed early can usually be treated with eyedrops. "Anyone over 40 should have regular, routine and comprehensive eye tests," said Mr. Wright. There were
comparatively few women in the Japanese study because men comprise most of the workforce there. The researchers also said it was difficult to establish exactly who might have had a family history of glaucoma because it often went undiagnosed for a long time. They suggested, however, that the optic nerve in myopic eyes might be much more susceptible to computer stress. "Computer stress is reaching higher levels than has ever been experienced before. In the next decade, therefore, it might be important for public health professionals to show more concern about myopia and visual field abnormalities in heavy computer users." The type of chronic glaucoma that was a concern in the Japanese study is the most prevalent in Caucasian and African-Caribbean populations. Close blood relatives of people who have glaucoma are at far higher risk, and the IGA says such people should be tested from the age of 35, rather than 40. For African-Caribbeans, for whom the risk is four times as high as whites, or for those with diabetes, testing should be done even earlier. If the condition is advanced, or drops fail to reduce eye pressure, surgery might be needed to make an extra drainage channel in the white of the eye. Alternatively, laser treatment might be used to improve the flow of fluid through the meshwork around the iris [55].

Kathryn et al., made a research work on Myopia, Lifestyle, and Schooling in Students of Chinese Ethnicity in Singapore and Sydney Objective: To compare the prevalence and risk factors for myopia in 6- and 7-year-old children of Chinese ethnicity in Sydney and Singapore. Methods: Two cross-sectional samples of age- and ethnicity-matched primary school children participated: 124 from the Sydney Myopia Study and 628 from the Singapore Cohort Study on the Risk Factors for Myopia. Cyclopleadic autorefractometry was used to determine myopia prevalence (spherical equivalent – 0.5 diopter). Lifestyle activities were ascertained by questionnaire. Results: The prevalence of myopia in 6- and 7-year-old children of Chinese ethnicity was significantly lower in Sydney (3.3%) than in Singapore (29.1%) (P < .001). The prevalence of myopia in 1 or more parents was 68% in Sydney and 71% in Singapore. Children in Singapore read more books per week (P < .001) and did more total near-work activity (P = .002). Children in Sydney spent more time on outdoor activities (13.75 Vs 3.05 hours per week; P < .001),
which was the most significant factor associated with the differences in the prevalence of myopia between the 2 sites. Conclusions: The lower prevalence of myopia in Sydney was associated with increased hours of outdoor activities. We hypothesize that another factor contributing to the differences in the prevalence of myopia may be the early educational pressures found in Singapore but not in Sydney [56].

Kathryn et al., conducted a study on Outdoor Activity Reduces the Prevalence of Myopia in Children. Objective: To assess the relationship of near, midworking distance, and outdoor activities with prevalence of myopia in school-aged children. Design: Cross-sectional study of 2 age samples from 51 Sydney schools, selected using a random cluster design. Participants: One thousand seven hundred sixty-five 6-year-olds (year 1) and 2367 12-year-olds (year 7) participated in the Sydney Myopia Study from 2003 to 2005. Methods: Children had a comprehensive eye examination, including cycloplegic refraction. Parents and children completed detailed questionnaires on activity. Main Outcome Measures: Myopia prevalence and mean spherical equivalent (SE) in relation to patterns of near, midworking distance, and outdoor activities. Myopia was defined as SE refraction ≤−0.5 diopters (D). Results: Higher levels of outdoor activity (sport and leisure activities) were associated with more hyperopic refractions and lower myopia prevalence in the 12-year-old students. Students who combined high levels of near work with low levels of outdoor activity had the least hyperopic mean refraction (+0.27 D; 95% confidence interval [CI], 0.02–0.52), whereas students who combined low levels of near work with high levels of outdoor activity had the most hyperopic mean refraction (+0.56 D; 95% CI, 0.38–0.75). Significant protective associations with increased outdoor activity were seen for the lowest (P = 0.04) and middle (P = 0.02) tertiles of near-work activity. The lowest odds ratios for myopia, after adjusting for confounders, were found in groups reporting the highest levels of outdoor activity. There were no associations between indoor sport and myopia. No consistent associations between refraction and measures of activity were seen in the 6-year-old sample. Conclusions: Higher levels of total time spent outdoors, rather
than sport per se, were associated with less myopia and a more hyperopic mean refraction, after adjusting for near work, parental myopia, and ethnicity [57].

**Sreeraman** conducted a study on *Increased Outdoor Activity Lessens Myopia Risk in Kids*. You might be scolding your kid for putting studies at stake, courtesy long hours of out-of-doors activities, but as it turns out, outdoor games are good for children, at least as far as their eyesight is concerned, says a new study. Researchers in Australia have found an association between high levels of outdoor activity and low rates of short-sightedness, or myopia, in children. The prevalence of childhood myopia has increased dramatically in recent decades. With rates of 80 percent in some East Asian populations, the search is on for possible causes. "We know that there are genetic associations with myopia," New Scientist quoted Kathryn Rose of the University of Sydney in Australia, as saying. "But the rapid changes in myopia prevalence are not consistent with a simple genetic determination, since gene pools do not change sufficiently fast," Rose added. Suspecting that environmental factors might also be involved, Rose and colleagues set about investigating the effect that time spent outdoors has on the prevalence of myopia. In the study, 2367 12-year-old Australian schoolchildren underwent eye examinations and completed questionnaires about their daily activities. The lowest rates of myopia were associated with the highest rates of outdoor activity, irrespective of how much near work, such as reading, the children did. The children with the worst eyesight did lots of near work and spent very little time outside. Interestingly, the study found no benefit from playing sports indoors [58].

**Dirani et al.,** conducted a study on *Outdoor activity and myopia in Singapore teenage children*. Aim: To investigate the relationship of outdoor activities and myopia in Singapore teenage children. Methods: Teenage children (1249 participants), examined in the Singapore Cohort study Of Risk factors for Myopia (SCORM), during 2006 were included in analyses. Participants completed questionnaires that quantified total outdoor activity, and underwent an eye examination. Results: The mean total time spent on outdoor activity was 3.24 h/day. The total outdoor activity (h/day) was significantly associated with myopia, odds ratio 0.90 (95% CI 0.84 to 0.96) (p=0.004), after adjusting for age,
gender, ethnicity, school type, books read per week, height, parental myopia, parental education and intelligence quotient. In addition, the total time spent outdoors was associated with significantly less myopic refraction (regression coefficient = 0.17; CI 0.10 to 0.25; p<0.001) and shorter axial length (regression coefficient = -0.06 (CI -0.1 to -0.03, p<0.001). Total sports was also significantly negatively associated with myopia (p=0.008) but not indoor sports (p=0.16).

Conclusions: Participants who spent more time outdoors were less likely to be myopic. Thus, outdoor activity may protect against development of myopia in children, supporting recent Australian data. As near work did not predict outdoor activity, this can be viewed as an independent factor and not merely the reciprocal of near work [59].

Lu et al., made a research work on Associations between near work, outdoor activity, and myopia among adolescent students in rural China Objective: To study the associations between near work, outdoor activity, and myopia among children attending secondary school in rural China. Methods: Among a random cluster sample of 1892 children in Xichang, China, subjects with an uncorrected acuity of 6/12 or less in either eye (n = 984) and a 25% sample of children with normal vision (n = 248) underwent measurement of refractive error. Subjects were administered a questionnaire on parental education, time spent outdoors, and weekly time spent engaged in and preferred working distance for a variety of near-work activities. Results: Among 1232 children with refraction data, 998 (81.0%) completed the near-work survey. Their mean age was 14.6 years (SD, 0.8 years), 55.6% were girls, and 83.1% had myopia of -0.5 diopters or less (more myopia) in both eyes. Time and diopter-hours spent on near activities did not differ between children with and without myopia. In regression models, time spent on near activities and time outdoors were unassociated with myopia, adjusting for age, sex, and parental education. Conclusions: These and other recent results raise some doubts about the association between near work and myopia. Additional efforts to identify other environmental factors associated with myopia risk and that may be amenable to intervention are warranted [60].
Wu Pei-Chang et al., conducted a study on Effects of Outdoor Activities on Myopia Among Rural School Children in Taiwan. Purpose: The aim was to identify the prevalence and risk factors of myopia among elementary school students in a rural area of Taiwan. Methods: A cross-sectional study was conducted. Elementary school students aged 7-12 years were recruited from the two schools located on Chimei Island. Data were obtained by means of a parent questionnaire and ocular evaluations that included axial length and cycloplegic auto refraction. Results: One hundred and forty-five students were recruited for this study. Myopia prevalence was 31%. In univariate analysis, myopia was significantly associated with school year, myopic parent, and watching television (TV) (P < .0001, = 0.007 and = 0.029, respectively). Multiple logistic regression analysis revealed that myopia was significantly associated with school year and myopic parent. However, the effect of watching TV was not statistically significant (P = 0.059). Outdoor activity showed significance and was inversely associated with myopia (Odds Ratio [OR], = 0.3, 95% Confidence Interval [CI], = 0.1-0.9, P = 0.025). Conclusion: This study suggests that outdoor activities might be an important protecting factor for myopia in rural school children [61].

Sharma et al., made a research work on Effect Of Television Watching On Vision Of School Children In Rural Haryana. Objectives: To study the Effect of different factors associated with TV watching on vision in school children (6-15 years). Study Design: Cross-sectional. Setting: Govt. Senior Secondary Schools of Block Lakhanmajra. Participants: 1265 school children (6-15 years). Methodology: Out of 16 Govt. Senior Secondary Schools, 4 were randomly chosen. Students aged 6-15 years studying in class 1 to 10 were included in the study. Visual Acuity (VA) test was performed using Snellen’s E chart and an interview was done on the basis of questionnaire. The findings of clinical examination were recorded on a pre-tested Performa and were analyzed. Statistical Analysis: percentages, Chi-square test. Result: Out of 1265, 93 students did not watch TV. Out of the remaining 1172, 161 students (13.7 %) had defective vision. Out of 109 students (9.3 %) who watched TV in darkness, 24 students (22%) had defective vision. Out of 129 students (11 %) who watched TV from a distance of less than 5 feet, 27 students (20.9 %) had
defective vision. Out of 914 students (78%) who watched TV from a distance 5-10 feet, 113 students (12.4 %) had defective vision and out of 129 students (11%) who watched TV from a distance >10 feet, 21 students (16.3%) had defective vision. Prevalence of defective vision was more in cases of longer duration of TV watching.

Conclusion: Distance, duration and environment of television watching may be responsible for impairing a child’s visual development. Defective vision can have a long term impact on the learning abilities of school children [62].

2.5 STUDIES RELATED TO HEREDITY AND REFRACTIVE ERROR

John and Wissmann Conducted a study on The epidemiology of myopia. Many people have reduced unaided vision because of myopia, a spherical error of refraction. The biological theory of myopia views myopia as the result of genetically determined characteristics of eye tissues, whereas the use-abuse theory views myopia as the result of habitual use of the eye at a near focal length, near-work. The use-abuse theory implies that myopia is preventable whereas the biological theory does not. Myopia varies over age, gender, race, and ethnicity, level of education, social class and degree of urbanization. The explanation of the epidemiology of myopia in the use-abuse theory is that some types of people do more near-work than others. Using data from the Health Examination Survey of 12 to 17-year-olds conducted by the US Public Health Service (USPHS) from 1966–1970, this paper finds 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 [63].

Teikari et al., conducted a study on Impact of heredity in myopia. A series of 109 like-sexed twin pairs in the age group 30-31 years (54 monozygotic and 55 dizygotic) with one or both members of the twins with myopia was found in the Finnish Twin Cohort. The series was based on a random sample of 1,200 twins in one age stratum of the cohort. The twins received a questionnaire on their health status with special reference to eye diseases and symptoms. The refractive status of
the twin pairs was ascertained by asking the twins to send their latest prescription for
glasses to the authors or the refraction was obtained from the ophthalmologists or
opticians of the twins. The mean difference in refraction between the monozygotic
twins was 1.19 D in the right eyes and 1.15 D in the left eyes. The difference
between dizygotic pairs was 2.34 D in the right eyes and 2.47 D in the left eyes.
Analysis of variance showed that the difference in refraction [64].

Pacella et al., conducted a study on Role of genetic factors in the
etiology of juvenile-onset myopia based on a longitudinal study of refractive error.
In an attempt to determine the role of genetic factors in the development of myopia,
we examined the relationship of infantile refractive error and parental history to
juvenile-onset myopia and analyzed 43 pedigrees affected by juvenile-onset myopia.
Refraction data collected at regular intervals from a sample of juvenile subjects
participating in a 24-year longitudinal study of refractive error were used. Results
showed that children with two myopic parents were 6.42 times as likely to become
myopic as children with one or no myopic parents. Furthermore, children who had
refractions in the lower half of the distribution at 6 to 12 months of age were 4.33
times as likely to develop myopia as children who had refractions in the upper half
of the distribution at 6 to 12 months of age. The pedigree analysis indicated that
63% of individuals considered at risk for developing juvenile-onset myopia actually
became myopic, with an equal number of affected males and females. These results
suggest that juvenile-onset myopia of moderate amounts may be inherited as a
complex trait involving both genetic and environmental factors [65].

Hammond et al., conducted a study on Genes and environment in
refractive error: the twin eye study. Purpose: A classical twin study was performed
to examine the relative importance of genes and environment in refractive error.
Methods: Refractive error was examined in 226 monozygotic (MZ) and 280
dizygotic (DZ) twin pairs aged 49 to 79 years (mean age, 62.4 years). Using a
Humphrey-670 automatic refractor, continuous measures of spherical equivalent,
total astigmatism, and corneal astigmatism were recorded. Univariate and bivariate
maximum likelihood model fitting was used to estimate genetic and environmental
variance components using information from both eyes. Results: For the continuous
spectrum of myopia/ hyperopia, a model specifying additive genetic and unique environmental factors showed the best fit to the data, yielding a heritability of 84% to 86% (95% confidence interval [CI], 81%-89%). If myopia and hyperopia (< or = -0.5 D and > or = 0.5 D, respectively) were treated as binary traits, the heritability was 90% (95% CI, 81%-95%) for myopia and 89% (95% CI, 81%-94%) for hyperopia. For total and corneal astigmatism, modeling showed dominant genetic effects are important; dominant genetic effects accounted for 47% to 49% of the variance of total astigmatism (95% CI, 37%-55%) and 42% to 61% of corneal astigmatism variance (95% CI, 8%-71%), with additive genetic factors accounting for 1% to 4% and 4% to 18%, respectively (95% CIs, 0%-13% and 0%-60%, respectively). Conclusions: Genetic effects are of major importance in myopia/ hyperopia; astigmatism appears to be dominantly inherited [66].

Saw et al., conducted a study on Familial clustering and myopia progression in Singapore school children. Background: Familial factors may be related to the progression of myopia in children. A cohort study was conducted to determine the relationship between familial factors and myopia progression in children. Methods: From a larger clinical trial (n = 311), 153 Singapore children aged 6 -12 years were recruited to participate in a cohort study of the risk factors for myopia progression. An in-person interview was conducted whereby information on the history of myopia in first-degree relatives was obtained. Other information collected included housing type, parental education and income. Cycloplegic refractive error as measured by subjective refraction and autorefraction were ascertained every six months. The average length of follow-up was 28 months. Results: The adjusted mean rate of progression of myopia was -0.60 (95% confidence interval -0.66, -0.55) diopters per year. The average rate of progression of myopia for children with a parental history of myopia was -0.63 (95% confidence interval -0.69, -0.56) diopters per year compared to -0.42 (95% confidence interval -0.57, -0.27) diopters per year for children whose parents were not myopic. The different measures of family history of myopia were related to rate of change in refractive error and refractive error in the final visit. There was no association between close work and myopia progression. Conclusions: A positive family history
is related to the progression of myopia and final refractive error in Singapore children, thus supporting evidence that hereditary factors may play an important role in myopia progression [67].

Donald et al., conducted a study on Parental Myopia, Near Work, School Achievement, and Children’s Refractive Error 

Purpose: To quantify the degree of association between juvenile myopia and parental myopia, near work, and school achievement. Methods: Refractive error, parental refractive status, current level of near activities (assumed working distance-weighted hours per week spent studying, reading for pleasure, watching television, playing video games or working on the computer), hours per week spent playing sports, and level of school achievement (scores on the Iowa Tests of Basic Skills [ITBS].) were assessed in 366 eighth grade children who participated in the Orinda Longitudinal Study of Myopia in 1991 to 1996. Results: Children with myopia were more likely to have parents with myopia; to spend significantly more time studying, more time reading, and less time playing sports; and to score higher on the ITBS Reading and Total Language subtests than emmetropic children ($\chi^2$ and Wilcoxon rank-sum tests; $P< 0.024$). Multivariate logistic regression models showed no substantial confounding effects between parental myopia, near work, sports activity, and school achievement, suggesting that each factor has an independent association with myopia. The multivariate odds ratio (95% confidence interval) for two compared with no parents with myopia was 6.40 (2.17–18.87) and was 1.020 (1.008–1.032) for each diopter-hour per week of near work. Interactions between parental myopia and near work were not significant ($P = 0.67$), indicating no increase in the risk associated with near work with an increasing number of parents with myopia. Conclusions: Heredity was the most important factor associated with juvenile myopia, with smaller independent contributions from more near work, higher school achievement, and less time in sports activity. There was no evidence that children inherit a myopigenic environment or a susceptibility to the effects of near work from their parents [68].

Feldkamper and Schaeffel conducted a study on Interactions of genes and environment in myopia. Myopia is a condition in which the eye is too long for the focal length of cornea and lens, and the plane of sharp focus ends up in front of
the retina. Given that the growth of the length of the eye is normally controlled with extreme precision by an image-processing feedback mechanism in the retina, myopia can either be the result of inappropriate visual stimulation, genetically determined changes in the gain or offset of the feedback loops or of inappropriate responses of the target tissues. There is no doubt that an environmental component is involved and extended near work appears to be the major risk factor. However, there is also no doubt that myopia is inherited since myopic parents are much more likely to have myopic children, and myopia is far more frequent in Asian populations than in the USA or Europe, even if groups are compared that have performed similar amounts of near work. A number of systemic or ophthalmic diseases are associated with myopia, indicating that metabolic conditions may interfere either with the gains of the feedback loops or the responses of the target tissue, the sclera. Since there is still no therapy against myopia development, research is directed toward the identification of genes that control the axial elongation of the eye [69].

Liang et al., conducted a study on Impact of family history of high myopia on level and onset of myopia. Purpose: To investigate the impact of a positive family history of high myopia on the level and onset of myopia and its ocular components. Methods: A cross-sectional study was conducted. The participants (aged 17 to 45 years) were categorized into four groups: normal, mild, moderate, and high myopia. The age of first glasses for myopia was used as the onset of myopia. The impact of the family history on the level and the onset of myopia was quantified. Parental effect on corneal curvature (CC), anterior chamber depth (ACD), and axial length (AXL) was analyzed. Results: The study included 185 normal subjects, 170 mild, 140 moderate, and 392 high myopes. Family history was strongly associated with the probands' status (P < 6 x 10(-12)). When there was >or=1 highly myopic parent, the odds ratios (ORs) of developing mild or moderate myopia were between 2.5 and 3.7 (95% CI: 1.1-6.5) and the ORs of having high myopia were > 5.5 (95% CI: 3.2-12.6). A strong association (P = 2 x 10(-6)) between parental myopic state and the AXL in the subjects was also found, but there was no statistical relationship for ACD or CC. There was an association between high myopia in parents and the onset of myopia in children. Siblings had a weaker association with the level of myopia and had no effect on the onset of myopia. Conclusions: This study found strong familial effects on the level and onset of
myopia even after adjusting for environmental factors. The parental effect on ocular components in their offspring was primarily on AXL [70].

**Morgan and Kathryn** made a research work on *How genetic is school myopia*. Myopia is of diverse etiology. A small proportion of myopia is clearly familial, generally early in onset and of high level, with defined chromosomal localisations and in some cases, causal genetic mutations. However, in economically developed societies, most myopia appears during childhood, particularly during the school years. The chromosomal localizations characterized so far for high familial myopia do not seem to be relevant to school myopia. Family correlations in refractive error and axial length are consistent with a genetic contribution to variations in school myopia, but potentially confound shared genes and shared environments. High heritability values are obtained from twin studies, but rest on contestable assumptions, and require further critical analysis, particularly in view of the low heritability values obtained from parent–offspring correlations where there has been rapid environmental change between generations. Since heritability is a population-specific parameter, the values obtained on twins cannot be extrapolated to define the genetic contribution to variation in the general population. In addition, high heritability sets no limit to the potential for environmentally induced change. There is in fact strong evidence for rapid, environmentally induced change in the prevalence of myopia, associated with increased education and urbanisation. These environmental impacts have been found in all major branches of the human family, defined in modern molecular terms, with the exception of the Pacific Islanders, where the evidence is too limited to draw conclusions. The idea that populations of East Asian origin have an intrinsically higher prevalence of myopia is not supported by the very low prevalence reported for them in rural areas, and by the high prevalence of myopia reported for Indians in Singapore. A propensity to develop myopia in “myopigenic” environments thus appears to be a common human characteristic. Overall, while there may be a small genetic contribution to school myopia, detectable under conditions of low environmental variation, environmental change appears to be the major factor increasing the prevalence of myopia around the world. There is, moreover, little evidence to support the idea that individuals or populations differ in their susceptibility to environmental risk factors [71].
Jenny et al., conducted a study on *Ethnic Differences in the Impact of Parental Myopia: Findings from a Population-Based Study of 12-Year-Old Australian Children*. Purpose: To examine the influences of ethnicity, parental myopia, and near work on spherical equivalent refraction (SER) and axial length (AL) in a population-based sample of 12-year-old Australian children. Methods: Year-7 children in the Sydney Myopia Study (n = 2353, 75.3% response) underwent an ophthalmic examination including cycloplegic autorefraction (1% cyclopentolate) and ocular biometry (IOLMaster; Carl Zeiss Meditec GmbH, Jena, Germany). Data for parental myopia, ethnicity, near work, and outdoor activities were derived from questionnaires and were available for 1781 children. Optical prescriptions of parents were sought if the spectacles were used. Results: The prevalence of myopia in the children increased with the number of myopic parents (7.6%, 14.9%, and 43.6% for no, one, or two myopic parents). In parallel, the mean SER (±SE of the mean) was more negative (0.70 ± 0.08, 0.34 ± 0.09, and −0.55 ± 0.34 D), and the mean AL was longer (23.32 ± 0.05, 23.44 ± 0.06, and 23.62 ± 0.16 mm) after adjustment for demographic and environmental factors. In multivariate analyses, odds of childhood myopia did not change with higher levels of near work (odds ratio [OR] = 1.01; 95% confidence interval [CI] = 0.99–1.03). Interactions between parental myopia and ethnicity were significant for SER and AL (both \( P < 0.0001 \)), reflecting greater decreases in SER and greater increases in AL with the number of myopic parents in the children of East Asian ethnicity than in the children of European Caucasian ethnicity. In the nonmyopic children, there was no association between parental myopia and AL. Conclusions: In this sample, parental myopia was associated with more myopic SER and longer AL, with significant ethnic interaction [72].

Jones et al., conducted a study on *Parental history of myopia, sports and outdoor activities, and future myopia*. Purpose: To identify whether parental history of myopia and/or parent-reported children's visual activity levels can predict juvenile-onset myopia. Methods: Survey-based data from Orinda Longitudinal Study of Myopia subjects from 1989 to 2001 were used to predict future myopia. Univariate and multiple logistic regression analyses were performed, and receiver operator characteristic (ROC) curves were generated. Differences among the areas under the ROC curves were compared using the method of multiple comparisons with the best. Results: Of the 514 children eligible for this analysis, 111 (21.6%)
became myopic. Differences in the third grade between eventual myopes and nonmyopes were seen for the number of myopic parents (P < 0.001) and for the number of sports and outdoor activity hours per week (11.65 +/- 6.97 hours for nonmyopes vs. 7.98 +/- 6.54 hours for future myopes, P < 0.001). Analysis of the areas under the ROC curves showed three variables with a predictive value better than chance: the number of myopic parents, the number of sports and outdoor activity hours per week, and the number of reading hours per week. After controlling for sports and outdoor hours per week and parental myopia history, reading hours per week was no longer a statistically significant factor. The area under the curve for the parental myopia history and sports and outdoor activities model was 0.73. A significant interaction in the logistic model showed a differential effect of sport and outdoor activity hours per week based on a child's number of myopic parents. Conclusions: Parental history of myopia was an important predictor in univariate and multivariate models, with a differential effect of sports and outdoor activity hours per week based on the number of myopic parents. Lower amounts of sports and outdoor activity increased the odds of becoming myopic in those children with two myopic parents more than in those children with either zero or one myopic parent. The chance of becoming myopic for children with no myopic parents appears lowest in the children with the highest amount of sports and outdoor activity, compared with those with two myopic parents [73].

**Kurtz et al.**, made a research work on *Role of parental myopia in the progression of myopia and its interaction with treatment in COMET children.* Purpose: The present study investigated the relationship between parental refractive error and myopia progression in their offspring and the interaction between parental ametropia and the effects of wearing progressive-addition (PALs) or single-vision (SVLs) lenses on the progression of myopia in children enrolled in the Correction of Myopia Evaluation Trial (COMET). Methods: The progression of myopia in a subset of COMET children (N= 232; 49% of initial group) was defined as the difference in mean spherical equivalent refraction of both eyes obtained by cycloplegic autorefraction between the baseline and 5-year visit. Parental refractions were obtained by noncycloplegic autorefraction (81%) or from recent eye examination records (19%). Results: The number of myopic parents (mean spherical equivalent refraction < -0.75 D) was directly related to myopia progression among
children wearing SVLs: myopia in children with no (zero) myopic parents progressed (mean +/- SE) -1.81 +/- 0.18 D and with one myopic parent, -2.04 +/- 0.13) D; these amounts were significantly less than the progression of children with two myopic parents (-2.59 +/- 0.19 D). In the PAL group, progression was not significantly related to the number of myopic parents and was -2.01 D overall. Among children with two myopic parents, progression was -2.00 D in the PAL group, significantly less than the progression of children wearing SVLs (P = 0.03). Among children with zero or one myopic parent, progression did not differ significantly between the lens groups. When the data were adjusted for covariates, the interaction between treatment effect and number of myopic parents was significant (P = 0.01). Over the 5-year study period, axial length increased 0.93 +/- 0.07 mm in children with two myopic parents wearing PALs and 1.18 +/- 0.07 mm in children with two myopic parents wearing SVLs (P = 0.01). The axial length increase in children wearing SVLs and with two myopic parents was significantly more than the 0.89 +/- 0.07 mm increase in children wearing SVLs and with zero myopic parents (P = 0.015). Conclusions: Parental refraction was related to myopia progression and changes in axial length. Among COMET children with two myopic parents, myopia progression and increases in axial length were slower in the group wearing PALs than in those wearing SVLs, by a statistically significant but clinically minor amount. Because this study was ancillary to COMET and the present analyses are based on a subset of participants, conclusions must be regarded as suggestive [74].

Tang et al., conducted a study on A review of current approaches to identifying human genes involved in myopia. The prevalence of myopia is high in many parts of the world, particularly among the Orientals such as Chinese and Japanese. Like other complex diseases such as diabetes and hypertension, myopia is likely to be caused by both genetic and environmental factors, and possibly their interactions. Owing to multiple genes with small effects, genetic heterogeneity and phenotypic complexity, the study of the genetics of myopia poses a complex challenge. This paper reviews the current approaches to the genetic analysis of complex diseases and how these can be applied to the identification of genes that
predispose humans to myopia. These approaches include parametric linkage analysis, non-parametric linkage analysis like allele-sharing methods and genetic association studies. Basic concepts, advantages and disadvantages of these approaches are discussed and explained using examples from the literature on myopia. Microsatellites and single nucleotide polymorphisms are common genetic markers in the human genome and are indispensable tools for gene mapping. High throughput genotyping of millions of such markers has become feasible and efficient with recent technological advances. In turn, this makes the identification of myopia susceptibility genes a reality [75].

2.6 CONCLUSION

The investigator made a survey of related literature regarding the problem entitled. The above studies were conducted in foreign countries and also in India. But, in India all the studies were carried out in northern parts only. Hence the investigator decided to conduct this process of investigation in Tamil Nadu which is located in extreme south of India. And also the previous studies were conducted either in rural areas or in urban areas, but not in semi urban places. This also motivated the investigator to take over the investigation in Maraimalai Nagar which is located in semi urban area. The above Researchers adopted either survey method or single group design of experimental method. Even though the rotational group method is one of the best method in experimental studies to avoid the interference of intervening variables such as motivation, depression etc, the investigator adopted the parallel group design method to this process of investigation. Since, rotational group design is difficult one for investigator, in getting permission from the parents of control group students, time factor and also economic factor. Hence the parallel group design was adopted. In the following chapter, Objectives, Hypotheses, operational definitions of terms and the methods of investigation will be discussed in detail.