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A review study on prevalence of refractive error among school going, pre-school going and adults in urban and suburban areas

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Abstract

Significances: Nowadays refractive errors are one of the most significant causes of visual impairment among different age population throughout the world and also cause of preventable blindness which could be either treated or prevented by known, cost effective means if timely proper eye check-up and necessary steps are taken. So, it is important to do a gender based clinical study about prevalence of refractive errors among both of urban and suburban school going patient in Kolkata region.

Objectives

- Prevalence of emmetropia vs. ametropia.
- Prevalence of different types of refractive errors.
- Influence of gender in different types of refractive errors.
- Associated diseases connection with refractive media.

Aim of study: According to VISION 2020 as we know that “Right to Sight” which is the global initiative by both WHO and IAPB for the elimination of avoidable blindness. Aim of vision 2020 to provide a world in which nobody is needlessly visually impaired, where those with unavoidable vision loss can achieve their full potential. To fulfil the aim of vision 2020, at first, we need to know current refractive status scenario among the population at various urban and suburban region worldwide. So, it is necessary to do are view study on the base of prevalence of refractive error among school age, pre-school age, adult and older age people by studies done already on various cities both urban and suburban areas of Kolkata. So that we can make sure about current refractive status scenario of school going children population.

Expected outcome: It is expected from the study that significant amount of population is suffering from refractive errors and it is a leading cause of visual impairment.

Keywords: Prevalence, urban suburban, school going age, preschool age, adult age, gender base, refractive errors

Introduction

Now a day’s refractive errors are one of the most significant causes of visual impairment among school going children, pre-school children, adult and old age throughout the world and also cause of preventable blindness which could be either treated or prevented by known, cost effective means if timely proper eye check-up and necessary steps are taken. So, it is important to do a review study about prevalence of refractive errors among both of urban and suburban population based on clinical study already done on various popular cities in the world.

Objective

- Prevalence of emmetropia vs. ametropia
- Prevalence of different types of refractive errors
- Influence of gender in different types of refractive errors.
- Associated diseases connection like diabetes hypertension etc. with refractive status

Literature Review

A study aimed to investigate the current prevalence of myopia among population of school children in Japan on August 2019.

They concluded that current prevalence rates of myopia among elementary and junior high school children in Asia are high [3]. Another study aimed to investigate changes in the prevalence of myopia in third year junior high school (grade 9) students in the Haitian district of Beijing, China from 2006-2015. The prevalence of non-myopia (from 44.05% to 34.52%) and low myopia (from 32.27% to 20.73%) decreased, while prevalence of moderate myopia (from 19.72% to 38.06%) and high myopia (from 3.96% to 6.69%) significantly increased [63]. Another study done on comparison of prevalence and causes of Visual impairment among tribal children in native and urban school of Odisha, India. They concluded that location urban or rural did not influence the visual impairment profile of tribal children [5]. Another population-based study done on childhood blindness and visual impairment in the Narayani zone of Nepal. They classified visual impairment as mild moderate and severe [4]. Another study done on visual impairment on urban school children of low-income families in Kolkata, India. They had done among 2570 children from 10 primary school [65]. Another study done on prevalence in school children in Ejina, Gobi Desert children eye study. They had done school-based observation at Gobi Desert children eye study on prevalence and association of myopia in school children. They stated that prevalence of myopia in school children is high [8]. Another study done on outdoor activity and myopia among Primary school students in rural and urban region of Beijing. They tried to do Association of outdoor activity, ocular biometric parameters and myopia among grade 1 and grade 4 primary students in Beijing. The study had done by comprehensive eye examination including ocular biometry by optical low coherence reflectometry and non-cycloplegic refractometry. They stated about high prevalence of myopia and concluded that more remaining at outdoor may reduce the high prevalence of myopia in the young generation at Beijing [7]. Another study done on prevalence of refractive errors among school children in Shiraz, Iran. Their aim was to determine prevalence of refractive errors in Shiraz school children. Total 2130 students were sampled of which 1872 participated on study found greater prevalence of hypermetropia and also stated that hypermetropia significantly decreases with age. ($P=0.021$) [11]. Another cross-section study done on prevalence of refractive errors among school going children in Dezful, Iran. Total population was 5721 school children. Uncorrected visual acuity and best corrected visual acuity were determined and those with visual acuity of 20/40 or worse underwent a complete ophthalmic examination to determine the cause of visual impairment. They stated that myopia is not prevalent there but high rate of hypermetropia as they found under 15 years of age. They also said that age gender and ethnicity groups have been recommended [61]. Another study done on the refractive errors of school going children of Pokhara city in Nepal. There were 964 total subject and among of them 474 were boys and 490 were girls, selected between 10-19 years of age limit from 6 schools representing different region of Pokhara. They stated that percentages of myopia were found to be higher than hypermetropia and refractive errors were found significantly higher in public school children than Government schools. Because private schoolchildren spent maximum time in home work like watching TV and computers as compared to Government school children [60]. Another study done on prevalence of

myopia and refractive changes in students from 3-17 years of age from 1984-1996 on Japanese school going children. They stated that an early age at onset for myopia and a recent increase in the proportion of myopia students. They also said about need of further studies to shed light on the extent to which myopia is caused by environmental factors [9]. Another study done on prevalence of refractive errors among school children in rural central Ethiopia. They said that uncorrected refractive error is a common cause of visual impairment among school children in rural central Ethiopia and regular school screening programme needed to provide glasses at low cost or free charge for those who have refractive errors [10]. Another study done on refractive errors and visual impairment in school age children in Gombak district, Malaysia. Their aim was to assess the prevalence of refractive errors and visual impairment in school age children at Gombak district, a suburban area near Kuala Lumpur city. Age limit was 7-15 years. They said that impairment in school age children in Gombak district is overwhelmingly caused by myopia with high prevalence among children of Chinese ethnicity [52]. Another study done at Delhi on 2002 on refractive error in children in children in an urban population in New Delhi. Purpose was to find out prevalence of refractive errors and related visual impairment in school aged children in an urban population at New Delhi, India. They found that hypermetropia was present in 7.7% of children and myopia 7.4%. Hypermetropia was associated with female gender. Myopia was more common in children of fathers with higher levels of education [53]. Another study done on refractive error in children in rural population in India on 2003 at Mahbubnagar, Southern Indian state of Andhra Pradesh. Total population was 4414 from 4876 children were enumerated. They stated that Myopia risk associated with female gender and having a father with a higher level of schooling. Refractive error was the main cause of visual impairment in children aged between 7-15 years in rural area [51]. Another study done on refractive errors survey in primary school children (6-12-year age limit) in 2 provinces Bangkok and Nakhonpathom (One year result). Their aim was to assess the prevalence of refractive errors in primary school aged children in Bangkok and Nakhonpathom. Total population was 2340 from Bangkok and 1240 from Nakhonpathom. They concluded that refractive error was the case in 97.6% of eyes with reduced vision. High prevalence refractive errors found in the central part of Bangkok [54]. Another study done on Pakistan about National blindness and visual impairment survey research design, eye examination methodology and result of the pilot study. Aim was to establish age and gender specific prevalence rates and causes of blindness and low vision in children aged to 10-15 years and adults aged 30 years and older in Pakistan. They stated that refractive error was the main cause of <6/12 visual acuity followed by cataract, uncorrected aphakia and age-related macular disease [62]. Another cross-sectional study done on Mongolia, China among 2090 people. Their objective was to assess the prevalence and risk factors for refractive error (RE) in Han and Mongolian adults aged 40-80 years in rural Mongolia, China and to identify ethnic difference in refractive error between this population. They stated that age-adjusted prevalence of myopia in the Han population was higher than that in the Mongolian population (31.8% vs. 23.0%, $p<0.001$) [1]. Another study done on Inanda, Ntuzuma and

Kwa Mashu (INK) area of Durban, KwaZulu -Natal Province, South Africa. The prevalence of refractive error was 57.3%, myopia 11.4%, hyperopia 37.7% and astigmatism 25.7%. Myopia and astigmatism were significantly more prevalent in men ($p < 0.01$). Whereas hyperopia was more prevalent in women ($p < 0.01$) [12]. Another study done on Europe among adults about prevalence of refractive error. Refractive data (Mean spherical equivalent) collected between 1990 and 2013 from fifteen population-based cohort and cross-sectional studies of the European Eye Epidemiology consortium was combined in a random effect meta-analysis stratified by 5 years of age intervals and gender. They stated that high prevalence of myopia in younger participants [13]. Another study done on India among adults age on prevalence of refractive errors, uncorrected refractive error and uncorrected presbyopia. They stated that prevalence of uncorrected refractive error was 10.2% but heterogeneity in these estimates was very high. The prevalence of uncorrected presbyopia was 33% [14]. Another study done on Colombia about prevalence of refractive error, presbyopia and spectacle coverage in Bogota, Colombia. They stated that prevalence of uncorrected refractive error was 12.5%. Prevalence of presbyopia among 35 years and older was 55.2%. Spectacle coverage was 50.9% for distance vision and it was 33.9% for presbyopia [15]. Another study done at Delhi by rapid assessment of visual impairment to find out prevalence of visual impairment due to uncorrected refractive error. They stated that uncorrected refractive error most common cause of visual impairment (53.4%). The elder population as well as females were more likely to have visual impairment due to uncorrected refractive error [16]. Another study done on Shanghai, China about prevalence of visual impairment and refractive error in children aged 3-10 years. They stated that prevalence of myopia (Spherical equivalent ≤ -0.5 diopters [D] in at least one eye) increased from 1.78% in 3 years old to 52.2% in 10-year-olds while prevalence of hypermetropia (Spherical equivalent $\geq +2.0$ D) decreased from 17.8% among 3 years old to 2.6% by 10 years of age. High level was statistically associated with greater myopia prevalence. They also stated that prevalence of myopia was lower or comparable to that reported in other populations from age 3 to 5 years but increased dramatically after 6 years. A strong environmental role of schooling on myopia development [2]. Another study done on children in Malabo (Island of Bioko). Equivalent Guinea (West Central Africa) to evaluate the prevalence of refractive error in school children. They stated that mean refractive errors found were low and visual acuity was high in these children. Low prevalence of myopia but have significantly higher values who attended private schools. Astigmatism was the most frequent refractive error [17]. Another study done on rapid assessment of refractive error study in northern district of Bangladesh (Sirajganj) to determine prevalence of refractive error. They stated that burden of refractive error and presbyopia is substantial in Bangladesh. 95% people don't use any spectacle [18]. Another study done on Goro district, Gurage Zone, Ethiopia among rural school age children to rule out prevalence of refractive error and visual impairment. Total number of 570 school age children taken. Prevalence of refractive error was 3.5% (myopia 2.6% and hyperopia 0.9%), (Age 7-15). No child was found wearing corrective spectacles during the study period [19]. Another study done in Western Saudi Arabia among Children aged

3-10 years to rule out prevalence of uncorrected refractive errors. They found that prevalence of astigmatism (25.3%) was higher compared to that of anisometropia (7.4%) hypermetropia (1.5%) and myopia (0.7%) [20]. Another study done on Qinghai -Tibet Plateau among adolescents about prevalence of refractive error. Total 3246 students case taken to do vision and ocular disease screening. Lower prevalence of refractive errors found among Tibetan adolescents which may be related to less intensive schooling and greater exposure to sunlight [21]. Another study done on South Sinai, Egypt to know about the prevalence and causes of visual impairment among children. Study done among 1047 boys and 1023 girls mean age 10.7 ± 3.1 years. They stated that 29.4% of South Sinai children had some form of visual impairment 90.32% of which suffering by refractive errors (Mainly astigmatism) [22]. Another study done on school district of Philadelphia to rule out prevalence of refractive errors among school-age children attending Philadelphia public schools. 13.1% of school age children exhibited uncorrected refractive error [23]. Another study done on Ethekwini Municipality of KwaZulu Natal, Durban. South Africa about rapid assessment of refractive error. Number of populations 1516 participated. Low prevalence of uncorrected refractive error found (1.5%). 51.4% under spectacle coverage [55]. Another study done on Tapan China to rule out prevalence of refractive errors. Visual impairment and spectacle coverage in school children. The prevalence of clinically significant myopia varied markedly with ethnicity in school children sampled from a semi-rural region of China [24]. Another study done on Haripur district among school going aged Madrassa students to rule out prevalence of refractive errors. Myopia being 52.6% followed by hypermetropia 28.4% and astigmatism 19%. Myopia is an important problem in Madrassa population [25]. Another study done among school children of Lahore, Pakistan to assess the magnitude of refractive errors. 1000 subjects taken with mean age of 13.78 ± 1.72 years, 24.4% students affected by refractive errors in which myopia 52% followed by astigmatism 38.1% and hypermetropia 9.8% [26]. Another study done among adult aged 30 years and above of village Pawakah, Khyber Pakhtunkhwa (KPK) Pakistan. It was cross sectional survey in which 1000 individuals were included randomly & 917 subject participated. Uncorrected refractive errors found 23.9%. Prevalence of visual disabling refractive errors was 6.89%. Hypermetropia was 10.14% and myopia found 6.00% and astigmatism 5.6%. Presbyopia prevalence was 57.5%. (Ayesha S Abdullah *et al.* Jan-Mar 2015) [27]. Another study done among preschool children in Australia to determine the age and ethnicity specific prevalence of anisometropia. Anisometropia was uncommon with inter-ethnic differences in cylindrical anisometropia prevalence. They found an increasing risk of anisometropia with high myopia ≥ -1.0 D, hypermetropia $> +2.0$ D and astigmatism ≥ 1.5 D [28]. Another study done among preschool children in Xuzhou, China to assess prevalence of refractive error. 86.6% of children were emmetropia. Prevalence of myopia and hypermetropia was 0.9% and 14.3% respectively. No evidence of a myopia refractive shift over this age range [56]. Another study done among high school children in South Africa to determine the prevalence and distribution of refractive error and its association with gender, age and school grade level. They found that myopia was the most prevalent and findings on its association with age suggest

that the prevalence of myopia may be stabilizing at late teenage years^[57]. Another cross-sectional population-based study done to report the prevalence and causes of visual impairment in seven-year-old children in Iran and its relationship with socio-economic conditions. They stated that most common cause of visual impairment were refractive errors (81.8%) and amblyopia (14.5%). Astigmatism was the main refractive error leading to visual impairment specially from low-income families was higher^[29]. Another study done in Kahama district, Tanzania with rapid assessment of refractive error among 3230 subjects to rule out prevalence of refractive error, presbyopia and spectacle coverage. Uncorrected refractive error is a public health challenge. Presbyopia prevalence 46.5%^[30]. Another study done on Shanghai, China to rule out prevalence and associated risk factors of under corrected refractive errors among diabetes population. Survey done among 649 subjects of diabetic population. They stated that under corrected refractive error in diabetic adults was high in Shanghai^[31]. Another study done in Shanxi Province, China to estimate the prevalence and causes of visual impairment. The prevalence in rural areas was significantly higher than that in urban areas and higher in females than in males. Most common cause of visual impairment and blindness was cataract^[32]. Another study done among Korean children to rule out influence of parental refractive errors, prevalence of Myopia, 2008-2012 by Korean national health & nutrition examination survey. High prevalence of myopia found and children with myopia parents showed a significantly greater risk for myopia and high myopia^[64]. Another study done on Kota Bharu, Kelantan, Malaysia to rule out prevalence of refractive error among school children in Malay primary school. Total 840 subjects taken. 7.7% children found with uncorrected visual impairment. Main cause of uncorrected visual impairment was refractive error (90.7% of the total)^[33]. In another study done on Latinos (The Los Angeles Latino eye study) to find prevalence and risk factors of uncorrected refractive errors they said that prevalence of uncorrected refractive error is high (15.1%) in Latinos of primarily Mexican ancestry^[34]. Another study done among Slovak populations about prevalence of refractive error calculated using the Gullstrand Schematic eye. They stated that females were more hypermetropic than males. The calculation of refractive error using Gullstrand Schematic eye model showed a significant hypermetropic shift of more than +2D^[35]. Another study done at Zoba Maekel Eritrea by a rapid assessment of refractive error to rule out prevalence of refractive error and spectacle coverage. They found 6.4% of prevalence of refractive error and spectacle coverage for refractive error was 22.2%. Higher in males than females^[36]. Another study done on public instruction in Ibadan, Nigeria among drivers to rule out prevalence of refractive errors and attitude to spectacle. They stated that 16.7% refractive error present in drivers but 43.8% of these bilaterally visually impaired and do not wear corrective lenses while driving^[37]. Another study done at Baria, Vung Tang Province in Vietnam among school children to rule out prevalence of refractive error. They stated that refractive error was the cause of vision impairment in 92.7%, amblyopia 2.2%^[38]. Another study done to determine the prevalence of refractive error and their association with glycemic control among adults with type 2 diabetes mellitus (T2DM) in eastern China. 96% were found to have refractive errors^[58]. Another study done at Karachi to rule

out prevalence of refractive error in school children. Total 1000 children from 20 schools were selected. 8.9% prevalence of refractive error found^[39]. Another study done at Ireland among school children to rule out refractive error and visual impairment. They found prevalence of myopia (3.3%), hypermetropia (25%) and astigmatism (19.2%) among subject aged 6.7 years old. (Harrington SC *et al* 2019)^[59]. Another study done at Bangladesh to rule out prevalence of refractive error in Bangladeshi adults. They stated that 57.3% emmetropic, myopia 22.1% and 20.6% were hypermetropic^[40]. Prevalence of distance visual impairment was 2.7% with 71.8% correctable by refraction found at Canadian urban population^[41]. Refractive errors ranged from 84.2%-75.5% among 2 years -10/12 years found from a rural town in Poland. Refractive errors detected as myopic shift due to aging. Myopia prevalence increased from 2.2% to 6.3% in 6/7 to 10/12 years old child^[42]. The prevalence of myopia 11% and astigmatism 8.6% in young Singaporean Chinese are high but that of hypermetropia is low^[43]. The prevalence of mental retardation in Nepal is 4.1% and 34.4% of the suffering from refractive error and hypermetropia is common^[44]. The prevalence of myopia 35.6%, hyperopia 17.7% and astigmatism 32.6% found among adult population at Southern India. 70% had advanced cataract. (Joseph S *et al.* 2018)^[45]. The prevalence of myopia 3.64% and hyperopia 27.4% found among population aged above 15 years old found at Iran^[46]. Refractive errors and amblyopia were the principal cause for reduced visual acuity respectively 66.8% and 32.7% found at Baltimore among preschool children in an urban population^[47]. Reduced visual acuity was detected in 3.7% in worse eye and 1.6% in the better eye found aged 3-6 years children found in a metropolis China. Refractive errors and amblyopia were the principal cause for reduced visual acuity respectively 66.8% to 32.7%^[48]. Myopia 10.1%, hypermetropia 36.6% and astigmatism 17.7% found at a study in isolated population in Norfolk Island. The prevalence of myopia on Norfolk Island is lower than on mainland Australia^[49]. Another study done at rural Myanmar (Meiktila district) prevalence of refractive error and associated risk factors. Myopic (>-1.0D ->6.0D) patient found 42.7% significantly associated with age. Hypermetropia >+1.0D occurred in 15% and worse than 1.0D occurred in 30.6% of the population associated with age ($p < 0.001$). (Gupta A, *et al.* 2008)^[50].

Conclusion

Now-a-days with huge changes of lifestyle occurred among school going children, pre-school children, above 15 years, aged and older patient especially due to excessive amount of near work activity with indoor activity like computer or Smartphone depended lifestyle rather than outdoor like outdoor gaming, exercises etc. and also associated with different types of disease like obesity, diabetes mellitus, thyroid, arthritis, hypertension with high cholesterol problem etc. keeping in mind of these changes of lifestyle based on their activity can affect how much on their ocular health and refractive status among school going children, pre-school children, adult age and older age is important to determine. All the articles discussed above vary from one another and some of them described only on myopia or only on gradation of visual impairment like mild, moderate and severe. Some of them described on tribal students or only low-income economic status or very limited age limit.

According to VISION 2020 as we know that “Right to Sight” which is the global initiative by both WHO and IAPB for the elimination of avoidable blindness. Aim of vision 2020 to provide a world in which nobody is needlessly visually impaired, where those with unavoidable vision loss can achieve their full potential. To fulfil the aim of vision 2020, at first, we need to know current refractive status scenario among the population at Kolkata region. So, it is necessary to do a review study on prevalence of refractive errors done worldwide so that we can have an approximate value of refractive status at various developed and under developed cities both urban and suburban areas among various income status public so that we can make sure about current refractive status scenario of such population.

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