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RESEARCH ARTICLE – MEDICINE (MISCELLANEOUS)

Risk Factors Associated with Refractive Errors Among Children at Ibn Al-Haitham Teaching Eye Hospital in Baghdad, Iraq

Baydaa Jaber Shamran[1], Zainora Mohammed[1*], Norliza Mohamad Fadzil[1], Mohd Harimi Abd Rahman[1]

[1]Centre for Rehabilitation and Special Needs Study, Faculty of Health Sciences, University Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300, Kuala Lumpur, Malaysia

[*] Corresponding author: zainora@ukm.edu.my

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Abstract

Background: Refractive errors are a significant public health concern, particularly among children, as they can lead to visual impairment and adversely affect educational and social development.

Objective of study: This study investigated the risk factors associated with different types of refractive errors among children in Baghdad, Iraq.

Materials and Methods: A cross-sectional study was conducted at Ibn Al-Haitham Teaching Hospital, where children aged 6–15 years underwent comprehensive eye examinations, including distance and near visual acuity assessments using the Log MAR chart, along with objective and subjective refraction. Socio-demographic characteristics and potential risk factors of refractive error were collected using a structured interview with parents or guardians. Multinomial and binary logistic regression were used to determine the risk factors associated with refractive errors.

Results: A total of 384 children participated in the study. Multivariable analysis indicated that watching television for 2 hours or more daily was associated with increased odds of myopia, while maintaining a TV viewing distance of more than three meters significantly reduced the likelihood of myopia (Adj. OR: 0.32; 95% CI: 0.18–0.56; p<0.001). Older age was associated with a lower risk of myopia (Adj. OR: 0.89; 95% CI: 0.83–0.96; p=0.002). For hyperopia, watching television at a distance of more than 3 meters (Adj. OR: 5.18; 95% CI: 2.55–10.52; p<0.001) or at 2 meters (Adj. OR: 2.77; 95% CI: 1.43–5.37; p=0.003) was associated with increased odds.

Conclusion: This study identifies several modifiable risk factors associated with refractive errors in children in Baghdad, Iraq, highlighting the need for targeted interventions to promote healthy lifestyle habits and access to comprehensive vision screening and corrective devices.

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Keywords: Refractive Errors; Myopia; Hyperopia; Astigmatism; Risk Factors; Children.

1. Introduction

Refractive errors including myopia, hyperopia, and astigmatism are an important health issue of the population, especially the visual well-being and the general development of children. According to World Health Organization (WHO) [1], refractive errors are considered to be the major cause of visual impairment in the world with children being the most susceptible to the impact [2]. The conditions do not only affect the visual acuity but also affect the educational performance, social and long-term developmental outcomes negatively [3]. However, in Iraq, studies that have been done to identify the prevalence and risk factors of refractive errors in children are scarce. The purpose of this study is to determine the prevalence and risk factors of refractive error on children at Ibn Al Haitham Teaching Eye Hospital in Baghdad, Iraq.

Various researchers have found that there are many risk factors that cause refractive errors and these factors include age, gender, socioeconomic status, parental history, and lifestyle choices [4, 5]. An example is a positive correlation between myopia and near work activities and less outdoor activities, and hyperopia with old age and rural living condition [6, 7]. The correlation between lifestyle and refractive errors is especially frightening, and the modern educational process often encourages the use of prolonged near work, as it has been proven to be associated with myopia development [3]. These risk factors help in understanding the prevention and management strategies that can be developed and adapted to the local context to ensure successful prevention and management.

Studies have shown that occurrence of refractive errors differs among diverse population and geographical areas [8]. As an illustration, a study done in Saudi Arabia established that the most common refractive error among primary school students was the myopia with a prevalence rate of 65.6% [9,10]. Likewise, systematic review in India also indicated that refractive errors were high among school-going children, which creates awareness of the need to conduct eye tests and intervene early in life [11]. These results emphasize the need to conduct specific studies in context like the one in Baghdad to guide local health policies and teaching practice. In addition, genetic disposition is very important in the occurrence of refractive errors. According to a study by Hegazy et al. children with history of refractive errors in a family are considered to be at a risk [12]. This gene factor together with environmental aspects, including urbanization and lifestyle modification, are a compound interaction that contributes to the prevalence of refractive errors in children. As an example, city children usually lack the opportunity to enjoy the outdoor and have increased exposure to screens, which are also risks of myopia [13].

Other than the genetic and lifestyle factors, the socioeconomic status plays a significant role in the prevalence of refractive errors. Myopia has also been associated with increased family income [14], which may have been due to more access to the means of facilitating near work in educational materials [15]. Conversely, disadvantaged children might be un favored in receiving eye care services, which contributes to the aggravation of the condition of uncorrected refractive errors [16]. This is a gap that underscores the need to adopt special interventions to reduce environmental and socioeconomic factors determining eye health. Moreover, the importance of nutrition and health in general in occurrence of refractive errors is a developing field. There are some studies that indicate that the lack of some important vitamins, including Vitamin D, can be associated with increased prevalence of refractive errors among children [17]. This relationship underscores the need to view the health of children in a holistic manner, in which the nutritional situation is taken into account with references to the environmental and genetic factors.

2. Materials and Methods

2.1. Study design

This study was conducted as a cross-sectional study in October 2023 up to May 2024 at Ibn Al-Haitham Teaching Hospital, Baghdad, Iraq. The study is most appropriate in the hospital as it is an ophthalmology institution that serves a significant number of patients. The objective of the research was to determine the prevalence and the risk factors of refractive error in children in Ibn Al Haitham Teaching Eye Hospital, in Baghdad, Iraq. The classification of refractive errors follows that proposed in the Refractive Error Study in Children (RESC) [18].

2.2. Participants

The sample that was used on this study was determined using the formula suggested by Thompson taking into consideration a margin of error of 0.05 and a 95% confidence level [19]. To conduct the study, a total of 384 children between 6 and 15 years old were recruited into the study. Those children who had already had eye surgery were excluded to remove the possible confounding factors. Written informed consent was taken in all the participating children by the parents or legal guardians before the commencement of the study. A voluntary approach was used and ethical standards were observed by protecting the rights, privacy and confidentiality of the subjects and their families during the study.

2.3. Visual Acuity Assessment

A detailed eye check, distance and near-visual check were performed on every child using the LogMAR chart. Near visual acuity and distance were monocularly measured. Visual acuity outcomes were of the uncorrected visual acuity (UCVA), presenting visual acuity (PVA) with the presence of spectacles and best-corrected visual acuity (BCVA) after subjective refraction.

2.4. Refractive error assessment

The refractive error was determined first through objective measurement using a retinoscope of which was then checked by subjective refraction. Refractive errors classification was grounded on the RESC criterion which classifies the refractive errors as shown in Table 1.

Table 1. Categories of refractive error based on the refractive error study in children (RESC)

Type refractive error	Criteria
Emmetropia	SER > -0.50 DS and < +2.00 DS
Myopia	SER ≤ -0.50 DS
Hyperope	SER ≥ +2.00 DS
Astigmatism	Cylinder error ≥ -1.00 DC

SER, spherical equivalent refraction

2.5. Socio-demography and risk factors assessment

Parents or guardians were interviewed using structured interviews to gather information on the socio-demographic data such as family income, parental education, and eye health history. Besides, the data about the daily activities were also collected, including the amount of sleep, hours of studying, time on digital device, and outdoor games. This detailed data gathering was to evaluate the possible risk factors to do with refractive errors.

2.6. Statistical analysis

The SPSS version 26.0 and STATA version 14.0 were used to analyze the data. To summarize the study population, descriptive statistics were used to characterize them. Multinomial logistic regression had been applied to examine factors related to the various forms of refractive errors, whereas binary logistic regression was used to examine risk factors of various forms of refractive errors. The level of significance was established as $p < 0.05$ in all the statistical tests.

3. Results

The sample of the research was composed of 384 children having an average age of 9.4 + 2.8 years. There were 214 (55.7) males in the sample and 170 (44.3) females. The majority of them lived in cities (59.6%), and the level of family income was as follows, low (38.8%), medium (41.9%), and high (19.3%).

3.1. Prevalence of refractive errors

The results of refractive errors of the study participants are as follows: myopia (70.3%), hyperopia (22.9%), and astigmatism (22.9%).

3.2. Risk factors for refractive errors

The invariable analyses were conducted in order to investigate the crude relationships among each risk factor and different types of refractive errors. The risk factors were examined and covered with socio-demographic traits of the subjects and their parents, and daily activities. Table 2 summarizes the results.

Table 2. Descriptive risk factors based on refractive error (Myopia, Hyperopia, and Astigmatism)

Risk factors	**Types of refractive error**		
	Myopia	**Hyperopia**	**Astigmatism**
Age			
Mean ± SD	8.94 ± 2.65	10.00 ± 2.78	9.51 ± 3.01
Risk factors	n (%)	n (%)	n (%)
Gender			
Female	134 (49.6)	36 (40.9)	34 (38.6)
Male	136 (50.4)	52 (59.1)	54 (61.4)
Residential area			
Rural	125 (46.3)	21 (23.9)	23 (26.1)
Urban	145 (53.7)	67 (76.1)	65 (73.9)
Mother's eye history			
Astigmatism	84 (31.1)	23 (26.1)	39 (44.3)
Hyperopia	50 (18.5)	13 (14.8)	4 (4.5)
Myopia	136 (50.4)	52 (59.1)	45 (51.1)
Father's eye history			
Astigmatism	107 (39.6)	36 (40.9)	44 (50.0)
Hyperopia	54 (20.0)	22 (25.0)	7 (8.0)
Myopia	109 (40.4)	30 (34.1)	37 (42.0)
Hours of sleep			
<8 hour	29 (10.7)	10 (11.4)	13 (14.8)
8-9 hour	125 (46.3)	29 (33.0)	32 (36.4)
≥10 hour	116 (43.0)	49 (55.7)	43 (48.9)
Hours of study			
<4 hour	207 (76.7)	59 (67.0)	51 (58.0)
≥4 hour	63 (23.3)	29 (33.0)	37 (42.0)
Hours of digital screen			
Not used	22 (8.1)	10 (11.4)	6 (6.8)
<2 hour	112 (41.5)	34 (38.6)	46 (52.3)
≥2 hour	136 (50.4)	44 (50.0)	36 (40.9)
Hours of TV watching			
Not watching TV	27 (10.0)	9 (10.2)	6 (6.8)
<2 hour	100 (37.0)	55 (62.5)	48 (54.5)
≥2 hour	143 (53.0)	24 (27.3)	34 (38.6)
Distance of TV watching			
Not watching TV	27 (10.0)	9 (10.2)	6 (6.8)
>3 meters	28 (10.4)	29 (33.0)	19 (21.6)
2 meters	113 (41.9)	35 (39.8)	36 (40.9)
<1 meter	102 (37.8)	15 (17.0)	27 (30.7)
Outdoor activity			
No	166 (61.5)	74 (84.1)	66 (75.0)
Yes	104 (38.5)	14 (15.9)	22 (25.0)

The invariable analysis for myopia, hyperopia, and astigmatism is summarized in Table 3. Age and gender were significantly associated with myopia. Hyperopia was significantly associated with age and residential area, while astigmatism showed significant associations with residential area and parental history of astigmatism.

The results of the multivariable analysis, after accounting for potential confounders, are summarized in Tables 4. The analysis showed that older age was associated with lower odds of myopia. Watching TV for 2 hours or more increased the risk of myopia, while watching TV at a distance of more than 3 meters reduced the odd.

The results of the multivariable analysis, after accounting for potential confounders, are summarized in Tables 5. For hyperopia, watching television at a distance of more than 3 meters or at 2 meters increased the odds, whereas watching television for two hours or more and engaging in outdoor activities were associated with reduced odds.

The results of the multivariable analysis, after accounting for potential confounders, are summarized in Tables 6. In astigmatism, living in urban areas and studying for four hours or more per day were associated with higher odds, while a maternal history of myopia was associated with lower odds.

Table 3. Univariate analysis of associated risk factors for myopia, hyperopia, and astigmatism

Risk factors	Myopia			Hyperopia			Astigmatism		
	OR	**95% CI**	**p value**	**OR**	**95% CI**	**p value**	**OR**	**95%CI**	**p value**
Age	0.89	0.84-0.95	0.001*	1.12	1.03-1.21	0.009*	1.03	0.95-1.12	0.451
Gender									
Female	Ref			Ref			Ref		
Male	0.67	0.47-0.96	0.028*	1.23	0.77-1.96	0.388	1.38	0.86-2.20	0.183
Residential area									
Rural	Ref			Ref			Ref		
Urban	0.67	0.47- 0.95	0.027*	2.66	1.57-4.50	<0.001*	2.31	1.38-3.86	0.001*
Mother's eye history									
Astigmatism	0.93	0.64-1.35	0.688	0.72	0.43-1.20	0.204	1.92	1.20-3.08	0.006*
Hyperopia	1.23	0.77-1.97	0.375	0.81	0.43-1.54	0.520	0.19	0.07-0.54	0.002*
Myopia	0.95	0.67-1.34	0.768	1.49	0.93-2.37	0.096	1.01	0.64-1.60	>0.950
Father's eye history									
Astigmatism	1.02	0.72-1.46	0.899	1.08	0.68-1.73	0.745	1.69	1.07-2.69	0.026*
Hyperopia	0.96	0.63-1.49	0.869	1.40	0.81-2.39	0.227	0.29	0.13-0.65	0.003*
Myopia	1.00	0.70, 1.43	0.994	0.72	0.45-1.17	0.189	1.09	0.68-1.73	0.722
Hours of sleep									
<8 hour	Ref			Ref			Ref		
8-9 hour	2.45	1.44-4.17	0.001*	1.09	0.50-2.35	0.831	0.90	0.44-1.81	0.763
≥10 hour	2.00	1.18-3.40	0.010*	2.03	0.97-4.23	0.061	1.26	0.65-2.50	0.504
Hours of study									
<4 hour	Ref			Ref			Ref		
≥4 hour	0.65	0.44-0.96	0.031*	1.39	0.84-2.27	0.197	2.26	1.40-3.65	0.001*
Hours of digital screen									
Not used	Ref			Ref			Ref		
<2 hour	1.02	0.53-1.98	0.958	0.61	0.28-1.36	0.227	1.66	0.66-4.19	0.281
≥2 hour	1.05	0.55-2.02	0.889	0.67	0.31-1.46	0.316	0.99	0.39-2.52	0.985
Hours of TV watching									
Not watching TV	Ref			Ref			Ref		
<2 hour	0.57	0.31-1.06	0.075	1.30	0.59-2.85	0.511	1.76	0.71-4.39	0.222
≥2 hour	1.60	0.85-3.00	0.145	0.56	0.24-1.29	0.169	1.34	0.53-3.40	0.538
Distance of TV watching									
Not watching TV	Ref			Ref			Ref		
>3 meters	0.42	0.20-0.86	0.017*	2.39	1.02-5.60	0.045*	2.13	0.79-5.76	0.137
2 meters	1.00	0.54-1.87	0.998	0.92	0.41-2.06	0.830	1.53	0.60-3.86	0.371
<1 meter	1.21	0.64-2.29	0.569	0.43	0.17-1.05	0.063	1.34	0.52-3.47	0.541
Outdoor activity									
No	Ref			Ref			Ref		
Yes	1.70	1.17-2.48	0.006*	0.33	0.18- 0.60	<0.001*	0.63	0.37-1.06	0.079

* Statistically significant at $p<0.05$

Table 4. Multivariable analysis of risk factors for myopia

Risk factors	Myopia		
	Adj. OR	**95% CI**	**p value**
Age	0.89	0.83- 0.96	0.002*
Hours of TV watching			
Not watching TV	Ref		
<2 hour	0.79	0.41-1.53	0.487
≥2 hour	2.31	1.16-4.62	0.018*
Distance of TV watching			
Not watching TV	Ref		
>3 meters	0.32	0.18-0.56	<0.001*
2 meters	0.73	0.48-1.12	0.149
<1 meter#	-		

*Statistically significant at $p < 0.05$

Distance of watching TV of less than 1 meter was dropped from the model due to the multicollinearity issue.

Table 5. Multivariable analysis of risk factors for hyperopia

Risk factors	Hyperopia		
	Adj. OR	95% CI	p value
Hours of TV watching			
Not watching TV	Ref		
<2 hour	0.46	0.18-1.17	0.105
≥2 hour	0.22	0.08-0.58	0.002*
Distance of TV watching			
Not watching TV	Ref		
>3 meters	5.18	2.55-10.52	<0.001*
2 meters	2.77	1.43-5.37	0.003*
<1 meter#	-		-
Outdoor activity			
No	Ref		
Yes	0.39	0.20-0.75	0.005*

Statistically significant at $p < 0.05$

Distance of watching TV of less than 1 meter was dropped from the model due to the multicollinearity issue.

Table **6**. Multivariable analysis of risk factors for astigmatism

Risk factors	Astigmatism		
	Adj. OR	95% CI	p value
Residential area			
Rural	Ref		
Urban	2.04	1.20-3.44	0.008*
Mother's eye history			
Astigmatism			
Hyperopia			
Myopia	0.22	0.08-0.62	0.004*
Hours of study			
<4 hour	Ref		
≥4 hour	1.85	1.13-3.03	0.014*

* Statistically significant at $p < 0.05$

4. **Discussion**

In this study, a range of social, demographic, and behavioral factors associated with myopia, hyperopia, and astigmatism among Iraqi children were investigated. The findings of this study highlight the complex interplay among inherited traits, environmental conditions, and lifestyle factors that influence the development of refractive errors [20]. Myopia was the most frequently occurring refractive error. This study found a correlation between increased television exposure and increased chances of myopia, which has also been reported in previous studies that showed prolonged near-work, screen time, and myopia were correlated [21, 22]. This finding is also consistent with recent regional evidence demonstrating a significant association between screen media use patterns and myopia among pediatric patients in Saudi Arabia [23]. It was suggested that extended screen time and reduced outdoor activity, may be attributed to elongation of the axial length and consequently increase in myopia. However, the role of outdoor activity was found to be significantly weaker for pre-myopic children, who are already in the precursor stage to myopia, as reported in a recent randomized trial on protective effect of the outdoors activity [24].

Viewing television from a distance greater than three meters was associated with a lower risk of myopia, underscoring the importance of appropriate viewing habits in reducing refractive error risk. This finding is consistent with previous studies conducted in Ethiopia and Southeast Asia, which similarly reported an association between shorter viewing distances and increased prevalence of myopia [21, 25, 26]. In this study, younger age was associated with a higher likelihood of myopia, which may reflect an earlier onset potentially driven by increased exposure to digital devices and heightened educational demands at younger ages. In contrast [27] reported a progressive increase in myopia with advancing age and level of education among European children, based on data collected between 1999 and 2008. Although these findings may appear inconsistent, they likely reflect important differences in time frame, cohort characteristics, and analytical focus. Our study captures a more recent cohort exposed to substantially different environmental conditions, including intensified digital screen use and evolving educational practices. This temporal shift may contribute to an earlier onset of myopia in contemporary children. Therefore, the observed differences likely represent cohort and contextual effects rather than true contradictions between the studies, with sustained academic pressure and changing lifestyle potentially influencing both onset and progression across generations. Hyperopia was associated with the TV watching, distance of television watching and outdoor activity. The lower odds of hyperopia among children who watch television may reflect the influence of sustained visual tasks on refractive development. Prolonged accommodative demand during near activities has been hypothesized to induce axial elongation, thereby reducing the likelihood of persistent hyperopia [28]. However, given that conventional television viewing typically occurs at longer distances than other near-work activities, this association should be interpreted cautiously and may reflect broader patterns of screen-related behavior rather than direct accommodative effects alone. In this study, it was found that watching TV at longer viewing distance resulted in increased potential of hyperopia, possibly due to adaptive viewing behavior in hyperopic children who like sitting further to reduce the high need of accommodation [29].

Contrary to earlier studies that found protective effect of outdoor activity on risk of myopia [30], our study found lower risk of hyperopia with outdoor activity. Similar findings have been reported in the past, and it was hypothesized that since outdoor activities require less accommodation, it decrease the stimulation of ocular growth and consequently the eye remain hyperopic [28]. Astigmatism was associated with urban living, four hours or more studying a day and maternal myopia. This supported previous findings that reported children who lived in urban environment had higher risk of developing astigmatism [31,32]. Maternal history of myopia also has been found to reduce the risk of astigmatism that is attributable by the differences in parental awareness and health seeking behaviors that influence early detection and correction. The likelihood to have astigmatism was also associated with more than four hours of study a day, possibly because of the long-term demands of near-work and stress of accommodations [33]. The multivariable risk profile highlights the significance of lifestyle modifiable risk factors (especially viewing habits and near work trends) and contextual elements, such as living in the city. Education of the population on the eye health, incorporation of vision health education at schools, and encouraging early diagnosis among children who have hereditary risk could contribute to the burden reduction of refractive errors.

This research paper has a number of strengths that contribute to its effectiveness in the field of knowledge about refractive errors in children in Baghdad, Iraq. The use of the Refractive Error Study in Children (RESC) classification in classifying the types of the refractive errors that are observed is one of the main strengths. This is a standardized method to diagnose refractive errors and to be able to compare them with other works in the world which is why the results are more reliable. The effectiveness of the RESC classification has been well noted to identify and classify refractive errors in the pediatric population, and thus this classification is useful in this research scenario. Also, the detailed approach that is used in assessing the vision also adds strength to the study. Both objective and subjective refraction methods provided the possibility of initial measurement of refractive error and then its further adjustment by the feedback of the child, which made the assessment of the visual acuity more accurate. Additionally, the methodology has rigor in the form of the operational definition of the vision screening of the distance and near visual acuity assessment with the help of the LogMAR chart, which ensures that the measurements in different groups of people are comparable. Although it has these strengths, there are a number of limitations that ought to be recognized. The study was cross-sectional in nature, thus we cannot use the research design to make causal inferences about the dependence between the risk factors identified and the acquisition of refractive errors. Although associations were made, the temporal association of exposure and outcome could not be determined. Also, the use of parental reporting as a means to gather information about the daily activities of children could have brought about reporting bias since parents might not remember or approximate on how much time their children spent in front of the screen or outside. Besides that, the sampling group was selected in a clinical environment, which can also lead to selection bias, where children with more severe visual issues are more inclined to the services of eye care. This could restrict the generalization of the results to the entire community of children.

In conducting research on the factors affecting refractive errors in children, several important aspects are worth emphasizing in future studies to further the knowledge on the issue. Longitudinal studies are also necessary, as they have the ability to trace the evolution of refractive errors over a period of time and determine the role of different risk factors in their evolution. These researches would help in analyzing the alteration in refractive status concerning lifestyle changes, schooling practices, and environmental factors. The extension of the geographical application of the research to rural and underserved regions in Iraq and other parts of the Middle East would help to increase the understanding of the impact of environmental and socioeconomic factors on prevalence rates of refractive errors. A comparison of urban and rural populations would be a valuable contribution in terms of the effects of lifestyle and availability of eye care services. Moreover, in future research, a broader assortment of variables related to health, including nutritional condition and general health, should be included to assess their possible role in influencing the emergence of refractive errors. The exploration of particular dietary variables such as the level of vitamin D could lead to an understanding of preventive measures, which could be applied on the communal level. By filling in these gaps, future studies can add to a broadened perception of refractive errors and guide effective health interventions by the population.

5. Conclusion

This research paper has demonstrated that there are some risk factors which are modifiable and linked to refractive errors in children in Ibn Al-Haitham Teaching Eye Hospital in Baghdad, Iraq. The prevalence of refractive abnormalities, especially myopia is very high, and hence there is a need to launch public health programs to tackle these problems. Specific measures, including the popularization of the healthy lifestyle, the enhancement of outdoor activities, and access to full vision screens and corrective services, are essential to reduce the effects of refractive errors on the visual well-being of children and their development process overall. Moreover, the article highlights the role of parental history in the determination of the refractive errors in children, and thus, specific screening could be effective in children whose parents have the condition. The association between environmental, genetic and sociodemographic factors and the evolution of refractive errors in children in the Middle East region is a complicated issue that requires future longitudinal research to further explain the relationship between these factors. By taking into consideration the factors, the stakeholders will be able to strive to minimize the rate of occurrence of refractive errors and enhance the quality of the lives of children not only in Baghdad but also in other regions.

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Nomenclature & Symbols			
LE	Left Eye	DS	Diopter Sphere
RE	Right Eye	ICD-11	International Classification of Diseases
MAR	Minimum Angle of Resolution	UCVA	Uncorrected Visual Acuity
BCVA	Best Corrected Visual Acuity	WHO	World Health Organization
PVA	Presenting Visual Acuity	RESC	Refractive Error Study in Children

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