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Prevalence of Visual Impairment among Primary and Secondary School Children in Delta State, Nigeria.

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Abstract

Purpose: Visual impairment (VI) being a state of physiological or pathological disorders of vision poses a burden on human activities globally. The purpose of this study was to determine the prevalence and risk factors of VI among school children in Delta State.

Methods: A descriptive cross-sectional study of 201 respondents aged 6 to 19 years were randomly selected from primary and secondary schools in the three senatorial districts of Delta State. Participants were evaluated using a structured questionnaire, distance Snellen chart, ophthalmoscope, and torchlight. Vision status was defined using World Health Organization categories of visual impairment based on presenting visual acuity (PVA). Data were presented in frequency tables, charts and analysed with Chi-Square statistics. All p-values reported were two-tailed and statistical significance was defined as $P < 0.05$.

Results: The mean age of participants was 12.30± 3.14 years, while 118 (58.7%) were females. The overall prevalence of VI (PVA of <6/18 in the better eye) was 58 (28.9%). The prevalence of mild, moderate, and severe VI was 40 (19.9%), 13 (6.5%), and 5 (2.5%) respectively. Refractive error 47 (23.4%) was the leading cause of VI. The prevalence of VI was higher in females, children 13-19 years, and respondents whose parents' income per month was >100,000. These observed differences were not statistically significant (p>0.05)

Conclusion: Untreated refractive error was the leading cause of VI among school children in Delta State. This is an avoidable cause of VI that can be treated with spectacle prescription to ease the burden of visual loss.

Key words: Visual Impairment, Prevalence, Refractive Error, Glaucoma, Cornea Opacity, School Children

Introduction

Visual impairment (VI) is a state in which one or more functions of the visual system are troubled due to physiological or pathological disorders from either one or both eyes.[1] World Health Organization (WHO) in 2010 estimated that there were 285 million people visually

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impaired, of which 39 million were blind.[2] The burden of visual impairment has increased exponentially over the years. Globally, it is estimated that at least 2.2 billion people have a vision impairment or blindness, of which at least 1 billion have a vision impairment that could have been prevented or has yet to be addressed. This 1 billion people include those with moderate or severe distance vision impairment or blindness due to uncorrected refractive error (123.7 million), cataracts (65.2 million), glaucoma (6.9 million), corneal opacities (4.2 million), diabetic retinopathy (3 million), and trachoma (2 million), as well as near vision impairment caused by unaddressed presbyopia (826 million).[3] One individual becomes blind in each minute and a child in each 5 minutes, and almost one in 1000 children are blind. Childhood blindness is a major public health concern worldwide, and nearly half the causes are avoidable.[4] The burden of visual impairment is not distributed uniformly throughout the world. The prevalence of distance vision impairment in low- and middle-income regions is estimated to be four times higher than in high-income regions.[5] With regards to near vision, rates of uncorrected near vision impairment are estimated to be greater than 80% in western, eastern and central sub-Saharan Africa, while comparative rates in high-income regions of North America, Australasia, Western Europe, and of Asia-Pacific are reported to be lower than 10%. About 90% of visually impaired people are living in developing countries.[3] The principal causes of visual impairment and blindness in the world include uncorrected refractive error[6], un-operated cataract, glaucoma, age related macular degeneration, diabetic retinopathy (secondary to oxidative stress and anaemia), trachoma and corneal opacities (secondary to malnutrition and Vitamin deficiencies).[7,8] The most common causes of visual impairment in children worldwide was uncorrected refractive error followed by amblyopia, corneal diseases and retinal disorders.[9] Moreover, among working-aged adults and children, inherited retina and choroidal diseases were the leading cause of visual impairment and blindness.[10] Most of the causes of visual impairment and blindness are either preventable or treatable.[8] Visual impairment relates to other health challenges such as falls, causing dangerous consequences, such as fractures.[11] Visual impairment has been associated with unfavourable conditions, such as barriers in performing daily life activities and in social participation, poverty, underemployment, low work satisfaction, and early retirement from working life.[12] Visual impairment also

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12. Brunes A, Heir T. Visual impairment and employment in Norway. BMC Public Health. 2022;22:648-653. doi:10.1186/s12889-022-13077-0

predicts accelerated deterioration in physical functioning.[13] Children with blindness are more frequently hospitalized, and are more likely to die during childhood than a sighted child.[14]

Materials and methods

Study Design and Study Population

This was a descriptive cross-sectional study of school aged children in the three senatorial districts of Delta State, Nigeria. The study population for this study were children aged 6-19 years. Sample was collected from primary and secondary schools in each of the three senatorial districts of Delta State.

Sample size and Sampling Technique

The minimum sample size for this study was estimated using the formula;[15]

$$n = \frac{Z^2 p(1-p)}{e^2}$$

The prevalence of VI in school children 32.1% from a previous study in Nigeria[16], margin of error of 7% , 95% confidence interval and 15% non-response rate was considered to arrive at a sample size of 201.

A total of 201 primary and secondary school age children in Delta State were randomly enumerated for the study in each of the three senatorial districts (Delta South, Delta Central and Delta North). In the first stage, one local government was selected by simple random sampling from each of the three senatorial districts making a total of three (3) local government areas for the survey. In the second stage, one public primary school and one public secondary school was selected by balloting using simple random sampling from each of the three local government areas earlier selected making a total of three (3) public secondary schools and three (3) public primary schools in the three senatorial districts of Delta State. In the third stage, 33 respondents of primary school age (6-12 years) and secondary school age (13-19 years) were enumerated from each of the selected three (3) primary and three (3) secondary schools. Consent forms were given to respondents who gave assent to participate in the study a day prior to the survey for their parents or guardian to give their consent. Phone numbers of their parents or guardians were collected by the researchers and calls were made through to the available phone numbers to explain the aim of the study and the need for their consents. The first 33 respondents from each of the six (6) schools that came with their consent forms signed were randomly recruited into the study making a total of 198 respondents. A total of three more respondents had consent forms signed and were included in the study making a total of 201 respondents.

Data Collection and Data Analysis

Data were collected using questionnaire from the child's mother/guardian of all enumerated children. A close ended, pre-designed and pre-

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tested questionnaires were used to interview the study respondents to elicit information on family characteristics like educational level and employment status of parents; and information on individual characteristics like age and sex. Two-day training was conducted to familiarize the team of researcher with the instruments and procedures for the survey. The training emphasized qualitative intake of sociodemographic information using questionnaires, visual acuity (VA) assessment and the operational definitions of visual impairment in order to reduce intra/inter observer variations as well as ascertain the consistency and precision of the instruments used. A pilot study of 42 school age children were randomly selected outside the study area to test the feasibility of the study and the accuracy of the method (validity). Comprehensive clinical eye examination was done to ascertain the visual status of each child enumerated. Data were presented using frequency tables and pie chat, and analysed using SPSS version 28.0. Cross tabulation, Chi square test and Fisher's exact test were used to determine socio-demographic factors associated with visual impairment. All p-values reported were two tailed and statistical significances was defined as P =.05.

Assessment of Visual Status

Visual acuity (VA) is a simple, non-invasive measure of the visual system's ability to discriminate two high contrast points in space. Distance visual acuity is commonly assessed using a vision chart at a fixed distance of 6 metres or 20 feet.[17] The smallest line read on the chart is written as a fraction, where the numerator refers to the distance at which the chart is viewed, and the denominator is the distance at which a "healthy" eye is able to read that line of the vision chart. For example, a visual acuity of 6/18 means that, at 6 metres from the vision chart, a person can read a letter that someone with normal vision would be able to see at 18 metres. "Normal" vision is taken to be 6/6.

Presenting visual acuity (PVA) was assessed monocularly using the Snellen's chart, illiterate E, or picture chart for each eye depending on the level of literacy of the respondent. This was placed six metres (20 feet) away in an open space in daylight. The last completed line on the chart was recorded as the visual acuity for that eye. Trial lens set, retinoscope, distance snellen letter, picture and illiterate E charts were used to measure the visual acuity as well as determine the refractive status of each selected participant. Pen torch and ophthalmoscope were used to examine the external and internal integrity of the eyes respectively.

Visual acuity assessment was the criteria used to determine visual impairment in the better eye. *Normal/near normal* VA is presenting vision ≥ 6/12 in the better eye. Visual impairment was defined as a visual acuity of <6/18.[3,18] Visual impairment was categorized into blindness and

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low vision. Blindness is visual acuity of <3/60 or inability to count fingers at a distance of 3 meters, and low vision was visual acuity of <6/18 but ≥3/60. 3,18 In other words, visual impairment was categorized as

- *Mild visual impairment* (Mild VI): presenting VA <6/12 to 6/18 in the better eye.
- *Moderate visual impairment* (Mod VI): presenting VA of <6/18 to 6/60 in the better eye.
- *Severe visual impairment* (SVI): presenting VA of <6/60 to 3/60 in the better eye.
- *Blindness*: presenting VA (with glasses for distance if normally worn or unaided if glasses for distance not worn) of <3/60 in the better eye.

Ethical Consideration

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Ethics Committee of Central Hospital, Warri, Delta State with protocol number: CHW/ECC VOL 1/243; approved 16 August, 2021 and Eku Government Hospital, Eku, Delta State with reference number: EBGH/AD/112/REM/V/101; approved 13 September, 2021. Permission to gain access to primary and secondary schools in the various LGA were obtained from the Local Education Authority (Reference number for Ukwuani Local Government Area; UKLGEA 175/11/24, dated 22nd September, 2021) and Chief Inspector Education (CIE) respectively. Written informed consent were obtained from parents or caregivers of the respondents and assent from each respondent child was sought as well.

RESULTS

In Table 1 above, 83 (41.3%) of the respondents were male and 118 (58.7%) were female with mean age of 12.30± 3.14 years. 72 (35.8%) were of primary school age (6-12 years), while 129 (64.2%) were of secondary school age (13-19 years). Majority of parent educational and employment status were secondary schooling 87 (43.3%) and self-employed 139 (69.2%) respectively. Majority of respondents parents 81 (40.3%) received income of less than ₦ 30, 000 per month.

In Table 2, the prevalence of visual impairment was slightly higher in females 28.9% than in male 28.8%. The association between visual impairment and gender was not statistically significant (χ^2 = 0.022, df = 1, P = 1.000). Prevalence of VI was higher in secondary school (13-19 years) age 35.6% (42) than in Primary school (6-12 years) age 22.2% (16). The association between visual impairment and age group was not statistically significant (χ2= 2.079, df= 1, P = 0.192). Regarding educational status of respondent's parents, 23.3% (20)

3. Bourne RRA, Flaxman SR, Braithwaite T, et al. Magnitude, temporal trends, and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. Lancet Glob Heal. 2017;5(9):e888-e897. doi:10.1016/S2214-109X(17)30293-0
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and 41.1% (30) with secondary and tertiary education respectively were visually impaired. The association between visual impairment and educational status of parent was not statistically significant ($\chi^2 = 7.528$, df = 4, P = 0.090). Majority 26.6% (37) of respondent's parents that were self-employed had impaired vision. Association of visual impairment was not statistically significant with employment status of parents ($\chi^2 = 2.455$, df = 3, P = 0.497). Prevalence of VI was higher in respondents whose parents' income per month was > ₦ 100,000 than those whose income per month was <₦30,000 having prevalence of VI of 45.0% (9) and 27.2% (22) respectively. The association between visual impairment and income per month of parents was not statistically significant ($\chi^2 = 5.806$, df = 4, P = 0.194).

In Table 3, 28.9% of the study respondents were visually impaired. Visual impairment was categorised into mild, moderate and severe with prevalence of 19.9%, 6.5% and severe 2.5% respectively.

In Fig. 1, refractive error with prevalence of 23.4% (47) was the major cause of VI among the respondents. Glaucoma and Cornea opacity constituted a prevalence of 4.5% (9) and 1.0% (2) respectively.

DISCUSSION

The prevalence of visual impairment (VI) in this study was 28.9%. This was similar to the study conducted in India with a prevalence of VI of 26.68%.[19] The VI prevalence of 28.9% in this study was higher than the prevalence of 6.7% among school children aged 5 to < 16 years in Ogun State, Nigeria[20], 7.3%, 21.5% and 32.1% in different studies in Cross Rivers State[16,21,22], 2.15% in South Africa[23], 5.5% in Khartoum, Sudan[24], 4.4% in South Darfur, Sudan[25], 7.0% and 9.5% in Ethiopia[26,27], 8.0% among school children 8-18 years in North West Ethiopia[28], 3.6% in Northern Ireland[29], 9.1% in Nepal[30], 2.67% and 4.82% in Brazil[31], 6.37% and 7.7% in two regions of China[32], and 6.4% in Australia[33]. This higher prevalence of VI is probably due to variation in the measurement of visual impairment, where

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in this study, children presenting with a visual acuity of <6/18 in the better eye were considered as visually impaired, whereas majority of the above studies used children presenting with a visual acuity of less than or equal to 6/12 and vision ≤ 6/9. In addition, the discrepancy could also be attributed to the difference in age of children. This study included children up to age of 19 years since increasing age is an important predictor of visual impairment. Some of the studies are population-based house-to house studies which may include pre-schoolers and children dropped out school for various undetected ocular conditions. However, the VI prevalence of 28.9% in this study was slightly lower than the prevalence of 29.4% in Egypt[34], and much lower than 37.58% in North-East Ethiopia[35]. The leading cause of VI in this study was uncorrected refractive error (23.40%). This is in consonance with other studies.[3,5,36] The 7.3% prevalence of refractive error (RE) in school children reported by Faderin in Lagos, South West Nigeria[37], 7.4% by Nkanga in Enugu, South East Nigeria[38], 2.2% in Bayelsa, Nigeria[39] and 2.1% in South Eastern Nigeria[40] were much lower than the 23.4% reported in this study. Other studies whose reports were lower than that of this study includes; 10.2% and 12.9% in Ethiopian, 13.7% in Al-Hassa, Saudi Arabia, 13.3% in Ghana, 11.6% in Uganda, 19.5% in southern India and 21.4% in Vietnam.[41] Similar to the result of this study, 19.2% was reported in Singapore[42], 20% in America[43] and 23.0% in Southernmost China.[44] The 23.4% reported in this study is lower than the prevalence of 62.8% in Cross River State, Nigeria[45], 64.4% in Iran and 47% in Malaysia.[41] The differences in prevalence observed in these studies may be related to differences in case definitions and methodologies as well as ethnicity-related changes in genetic susceptibility to RE, such that Asian nations tend to have higher prevalence of RE.[46] In this study, the prevalence of VI was slightly higher in female 28.9% than in male 28.8%. Similar studies conducted in Saudi Arabia showed prevalence of 7.7% in male and 8.6% in female.[47] In Lagos, Nigeria prevalence of 44% in male and 56% in female[37] was reported. On the contrary, males were reported to have higher VI than females in North West

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Ethiopia with prevalence of 4.2% and 3.8% respectively.[28] In this study, the association between visual impairment and gender was not statistically significant. Other studies[25,48–50] found no significant association between gender and visual impairment. In this study, Primary school age (6-12 years) with VI prevalence of 22.2% was lower than the 35.6% prevalence in secondary school age group (13-19 years). In line with this finding, various studies[30,48,51] showed that higher education level increases the risk of visual impairment particularly myopia. The higher prevalence of visual impairment with higher school grade level may be attributed to more hours of near work and indoor activities.[52] Intensive indoor/near activities could result in retinal defocus which leads to axial length elongation, thereby causing visual impairment particularly myopia.[52,53] Despite the mark difference between the prevalence of primary and secondary age groups, the association between visual impairment and age group in this study was not statistically significant (p = 0.192). This may be related to the small sample size used in this study. Regarding educational status, 23.3% and 41.1% of children whose parents had secondary and tertiary education respectively were visually impaired. Whereas, 26.6% of children whose parent were self-employed were visually impaired. These findings may be ascribed to the parents as a result of their career pursuit relative to their educational and employment status, were not giving enough time and attention to their children's complaint of poor vision. Zelalem et al., revealed that children of people with low educational status and unemployed were more likely to be visually impaired or blind.[28] Another study conducted in Nigeria showed that the risk of being blind was doubled for participants who were illiterate.[54] In this study, the prevalence of VI was higher in respondents whose parents' income per month was > ₦ 100,000 with prevalence of 45.0% compared with those whose income per month was <₦30,000 with prevalence of 27.2%. The association between visual impairment and income per month of parents was not statistically significant (P = 0.194). On the contrary, the study done by Woldeamanuel et al. found that visual impairment was significantly associated with low family income.[48] Also, Andhra Pradesh study reported that the risk of visual impairment including blindness was found to increase with decrease in monthly income.[55] Jaggernath et al. study also reported that the burden of vision impairment is high in people with low income.[56]

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Moreover, students from low socioeconomic status spend longer time studying their lessons in badly illuminated, crowded rooms which can affect ocular growth and refractive error status.[57] The increase in visual impairment following increase in socioeconomic status as shown in this study may be related to frequent use of indoor games and computer related gadgets by children whose parents have higher income per month. Studies showed that long term use of computer (laptops) and similar gadgets (smartphones) has been linked to significant visual impairments.[58,59] Computer Vision Syndrome (CVS) which represents a group of visual and extraocular symptoms associated with sustained use of visual display terminals was shown to result in asthenopia, blurred vision, dry eye syndrome, and ocular congestion as the most frequent manifestations of VI.[60–62] The result of this study not being able to establish significant relationship between the variables may be due to the small sample size used, which is major limitation to this study.

Conclusion

The burden of visual impairment among primary and secondary school children in Delta State was high. Uncorrected refractive error was the commonest visual impairment among school children. Various socio-demographic and economic factors such as gender, age group, educational status of parent, employment status of parent and income per month of parents were not significantly associated with visual impairment in this study. The limitation of this study includes the use of small sample size and only three (3) Local Government Area was surveyed, lack of robust analysis to establish association and the use of cross-sectional study to estimate cause and effect. Hence, the result of this study may not be generalized to the entire population of primary and secondary school children in Delta State, Nigeria. Therefore, large scale survey is required to determine the socio-demographic and economic factors associated with visual impairment among school children in Delta State.

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Table 1: Socio-demographic characteristics of the respondents

Variable	Frequency (n = 201)	Percent (%)
Gender		
Male	83	41.3
Female	118	58.7
School Age Group*		
Primary School age (6-12 Years)	72	35.8
Secondary School age (13-19 Years)	129	64.2
Parent Educational Status		
No Schooling	11	5.5
Primary Schooling	29	19.9
Secondary Schooling	87	43.3
Tertiary Schooling	72	35.8
Employment Status of Parent		
Unemployed	16	8.0
Employed	29	14.4
Self Employed	139	69.2
No Response	17	8.4
Income Per Month of Parent		
< 30,000	81	40.3
30,000 - 50,000	72	35.8
51,000 - 100,000	26	12.9
> 100,000	20	10.0
No Response	2	1.0

*Mean age ± standard deviation = 12.30 ± 3.14 years

Table 2: Association between sociodemographic characteristics and Visual Impairment among Respondents

Variables	Category	Visual Impairment			
		Yes n = 58 (%)	No n= 143 (%)	χ^2	P-Value* (P<0.05)
Gender	Male	24 (28.9)	59 (71.1)	0.022	1.000
	Female	34 (28.8)	84 (71.2)		
Age Group	Primary (6 - 12 years)	16 (22.2)	56 (77.8)	2.079	0.192
	Secondary (13 - 19 years)	42 (35.6)	87 (67.4)		
Educational Status of Parent	No Schooling	2 (18.2)	9 (81.8)	7.528	0.090+
	Primary School	6 (20.7)	23 (79.3)		
	Secondary School	20 (23.3)	66 (76.7)		
	Tertiary School	30 (41.1)	43 (58.9)		
	No Response	0 (0)	2 (100)		
Employment Status of Parent	Unemployed	6 (37.5)	10 (62.5)	2.455	0.497
	Employed	8 (27.6)	21 (72.4)		
	Self-Employed	37 (26.6)	102 (73.4)		
	No Response	7 (41.2)	10 (58.8)		
Income per Month	< 30,000	22 (27.2)	59 (72.8)	5.806	0.194+
	30,000 - 50,000	17 (23.6)	55 (76.4)		
	51,000 - 100,000	10 (38.5)	16 (61.5)		
	> 100,000	9 (45.0)	11 (55.0)		
	No Response	0 (0)	2 (100)		

***Chi-square test, +Fisher's exact test**

Table 3: Prevalence and Categories of Visual Impairment

Variable	Frequency (n = 201)	Percent
Visual Impairment		
Normal Vision	143	71.1
Visually Impaired	58	28.9
Visual Impairment Category		
Normal (VA > or = 6/12)	143	71.1
Mild (< 6/12 - 6/18)	40	19.9
Moderate (< 6/18 - 6/60)	13	6.5
Severe (< 6/60 - 3/60)	5	2.5

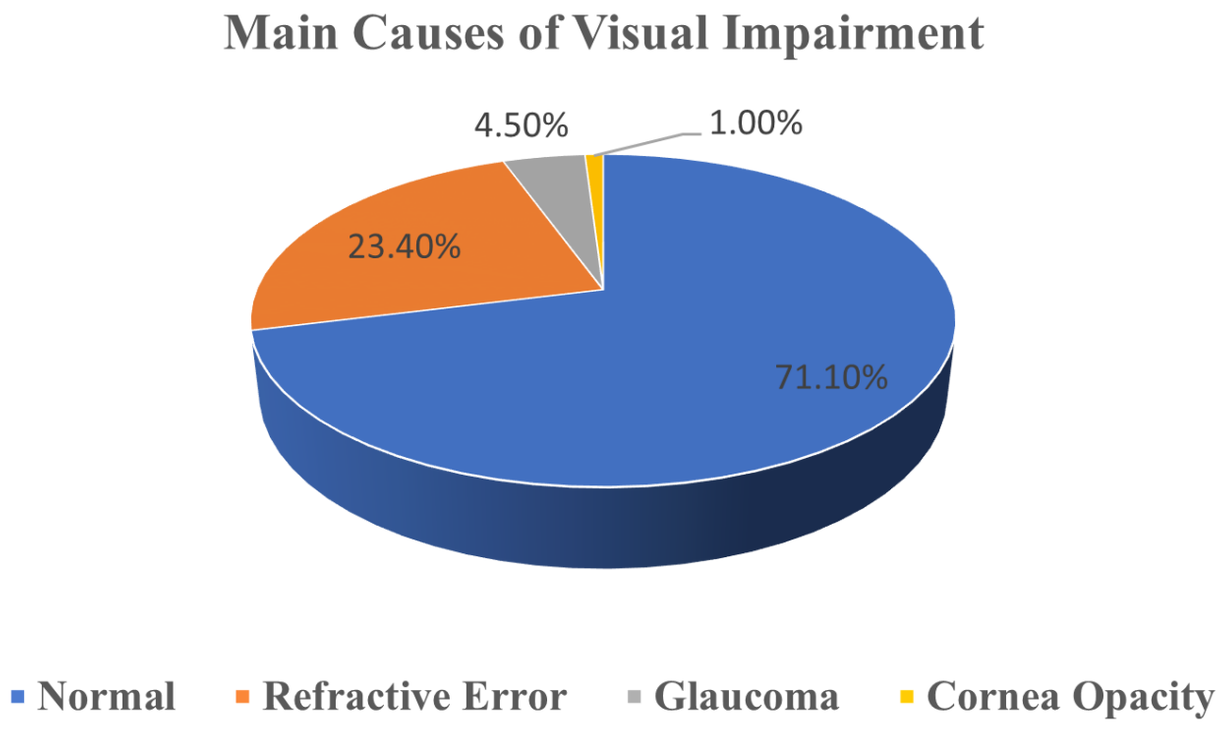

Fig. 1: Main Causes of Visual Impairment among Respondents

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