**Prevalence and causes of visual impairment and blindness among primary schoolchildren in Herat, Afghanistan**

Aziz-ur-Rahman NIAZI (PhD)1,2,3, Sayed Javid SADAT2, Mina ALEKOZAY (MD)1, Mohammad Naser AKHONDZADAH (MD)4, Abdul Fattah NAJM (MD)2

1 Department of Public Health and Infectious Diseases, Faculty of Medicine, Herat University, Herat, Afghanistan

2 International Assistance Mission, Herat Office

3 Roshana Specialty Eye Hospital

4 Herat Ophthalmic Center

**Abstract**

Childhood visual impairment and blindness (VI&B) significantly affects socioeconomic status and health of an individual in adult age. The prevalence and etiology of VI&B in children varies considerably around the world and across different studies. This study aims to identify the prevalence and causes of VI&B among schoolchildren in Herat, Afghanistan. This school-based cross-sectional study was conducted through a stratified cluster sampling on schoolchildren of both sexes aged between 7 and 15 years, between September and December 2021. Visual acuity of study participants was assessed using standard Snellen chart. Participants with VI&B were further assessed for identification of etiology. Data was analyzed in IBM SPSS Statistics (version 27). A total of 8930 schoolchildren, comprising 4366 (48.9%) boys and 4564 (51.1%) girls with a mean age of 10.1 ± 2.3 years were examined. The prevalence of VI&B in the worst eye was 5.2% (5.0% VI and 0.2% blindness). Of the 4366 boys in this study, 228 (5.2%) had VI, while 17 (0.4%) had blindness, while of the 4564 girls in this study, 211 (4.6%) had VI and 4 (0.1%) had blindness in the worst eye. Refractive error was the principle cause of VI&B in 334 (72.6% of the visually-impaired and 3.6% of the overall sample population). This is the first comprehensive study that reports the prevalence and causes of VI&B in schoolchildren in Afghanistan. The prevalence of VI&B among participants was high in Herat, and the principle cause was uncorrected refractive error.

***Keywords***: Prevalence, visual impairment, blindness, schoolchildren, Herat, Afghanistan

**INTRODUCTION**

Normal vision is essential for performing daily activities. Visual impairment and blindness (VI&B) negatively impact on social, recreational, educational and physical functioning and tasks of everyday life (Swenor et al., 2020). According to the World Health Organization (WHO), in 2021, at least 2.2 billion people suffered from near or distance visual impairment (VI) in the world (World Health Organization, 2021a). In Afghanistan, in 2021, over 1.5 million people had VI, 400,000 were blind and approximately 25,000 people had lost vision (World Heatlh Oranization, 2021b).

The prevalence of VI&B among children has considerable geographical variation. The lowest prevalence of VI among schoolchildren (5-15 years old) has been reported from South Africa (1.4%; Naidoo et al., 2003), while the highest prevalence was reported from Nepal (18.6%; Sapkota et al., 2008). Variation in the prevalence of VI&B in different studies may probably be due to several factors such as ethnicity, population characteristics, socioeconomic, environment, and study methodology (Pi et al., 2012).

Several studies have reported uncorrected refractive error as the leading cause of VI&B in schoolchildren (Ahmed et al., 2020; Ezegwui et al., 2021; Pi et al., 2012; Sapkota et al., 2008; Wadhwani et al., 2021). The prevalence of refractive error as the cause of VI&B varies from 16.3% in Saudi Arabia (Sharma et al., 2020), to 94.2% in Bhutan (Sharma et al., 2020). Other less common causes of VI&B in schoolchildren include strabismus, amblyopia, corneal opacity, cataract, and glaucoma (Ezegwui et al., 2021; He et al., 2014; Kedir and Girma 2014; Panda et al., 2019; Pi et al., 2012).

In children, VI&B pose a huge public health, economic, social and cultural challenge in the world. Early onset VI in children can lead to delayed cognitive, emotional, social, language and motor development, leading to serious consequences (World Health Organization, 2021a).

Data on the prevalence of VI&B among children in Afghanistan is very scarce. Only two population-based studies from Kabul and Nangarhar, and a school-based survey from Herat are available (Abdianwall & Dogan, 2018, Niazi & Hossaini, 2017; Sapkota et al., 2021). The current study aims to determine the prevalence and causes of VI&B among primary schoolchildren in Herat, Afghanistan.

**MATERIALS AND METHODS**

**Study design, setting, and duration**

This school-based cross-sectional study was conducted between September and December 2021, among primary schoolchildren in Herat city of Afghanistan.

**Sample size** a

According to Herat Department of Education, in 2021, a total of 117,693 children were studying in primary schools of Herat city. The minimum sample size was estimated at 8,880 schoolchildren, with a 99% confidence interval, and 95% confidence level, using the raosoft sample size calculator.

**Sampling strategy**

In 2021, there were 103 primary schools in Herat, of which 20 were randomly selected (10 males primary schools and 10 females primary schools). A stratified multi-stage cluster sampling was employed to select samples. From each school, one class from each grade was selected randomly (if the school had more than one class for each grade), and all students enrolled in that class were included in the study.

**Visual acuity examination**

Visual acuity (VA) was examined by two ophthalmic nurses, under daylight illumination, using standard Snellen chart (Matronix India Corporation, India). Each student was placed at 6-meter distance from the chart, and the VA of each eye was measured separately, with the fellow eye being occluded. In case the student was wearing spectacles, the VA was assessed while wearing the spectacles as well. The VA was classified as normal, mild VI, moderate VI, severe VI and blindness, as per the WHO guideline (World Health Organization, 2021a). Cases with VI&B were referred to Herat Ophthalmic Center for further examination.

**Follow-up examination**

Follow-up examination was conducted at Herat Ophthalmic Center to determine the causes of VI&B. The anterior segment of the eye was examined by an ophthalmologist under a slitlamp biomicroscopy (Sun Kingdom, China). Posterior segment was examined with a fully-dilated pupil, using slitlamp biomicroscopy and a 90-diopter aspheric lens (Opticlear, India). The Ophthalmologist assessed the patient for the presence of strabismus, cataract, glaucoma, corneal opacities and Bitot’s spots; and for symptoms such as itching, burning sensation, dryness, redness, watering, and headache. The presence of refractive error was assessed by a registered optic technician using a RM-800 Auto Refractometer (Topcon, Japan) objectively; and a trial frame lens set (Joyfay, Turkey) and the Snellen chart (Matronix India Corporation, India), subjectively. Ocular motility was examined using a hand torch. Findings were recorded in a specific form, designed for this project. Approximately 2% of students with normal VA were randomly referred by ophthalmic assistants for further ocular and refractive assessment; all these students were reported normal in the follow-up examination.

**Data analysis**

Data were recorded in IBM SPSS Statistics (version 27). Categorical variables are presented as numbers and percentages. Continuous variables are shown as mean ± standard deviation (SD). A Chi-square test was employed to assess the association between categorical variables. Statistical analyses were performed by setting the significance level to 0.05.

**Ethic consideration**

Prior to the commencement of the project, the study protocol was reviewed and approved by the Human Ethics Committee of Herat University (Approval number #200221). A written informed consent was obtained from students’ guardians prior to the assessment of VA and acquisition of data. Privacy and confidentiality of information was maintained throughout the study.

**RESULTS**

**Participants’ characteristics**

A total of 8930 schoolchildren comprising 4366 (48.9%) boys and 4564 (51.1%) girls were included in this study. The overall mean age of participants was 10.1 ± 2.3 years. **Table 1** displays the number of study participants according to sex, age and class.

**Prevalence of visual impairment and blindness**

Of the 8930 participants in this study, 8470 (94.8%) had a normal vision in their right eyes, while 8507 (95.3%) had a normal vision in their left eyes**. Table 2** shows the number of study participants according to sex, laterality of the eye and categories of VA. As it can be seen in **Table 2**, of the 4366 boys in this study, 228 (5.2%) had VI, while 17 (0.4%) had blindness in their right eyes. Concerning the left eye, 222 (5.1%) had VI, while 9 (0.2%) had blindness.

**Table 1.** The number and percentages of study participants according to sex, age and class

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Boys | | Girls | | Total | | p value\* |
| n | % | n | % | n | % |
| **Age** **(years)** |  |  |  |  |  |  |  |
| 7 | 434 | 9.9 | 1001 | 22.0 | 1435 | 15.9 | <0.001 |
| 8 | 416 | 9.5 | 712 | 15.6 | 1128 | 12.6 |
| 9 | 456 | 10.4 | 632 | 13.8 | 1088 | 12.1 |
| 10 | 684 | 15.7 | 563 | 12.3 | 1247 | 14.1 |
| 11 | 575 | 13.2 | 585 | 12.8 | 1160 | 13.0 |
| 12 | 784 | 18.0 | 727 | 15.9 | 1511 | 16.9 |
| 13 | 568 | 13.0 | 283 | 6.2 | 851 | 9.6 |
| 14 | 449 | 10.3 | 61 | 1.4 | 510 | 5.8 |
| **Total** | **4366** | **100.0** | **4564** | **100.0** | **8930** | **100.0** |  |
| **Classes (grades)** | | | | | | |  |
| 1 | 660 | 15.1 | 806 | 17.7 | 1466 | 16.4 | <0.001 |
| 2 | 685 | 15.7 | 724 | 15.9 | 1409 | 15.8 |
| 3 | 712 | 16.3 | 848 | 18.6 | 1560 | 17.4 |
| 4 | 762 | 17.5 | 899 | 19.7 | 1661 | 18.6 |
| 5 | 813 | 18.6 | 606 | 13.3 | 1419 | 15.9 |
| 6 | 734 | 16.8 | 681 | 14.9 | 1415 | 15.9 |
| **Total** | **4366** | **100.0** | **4564** | **100.0** | **8930** | **100.0** |  |

n: number; %: percentage;

\* The results of Chi-square assessment

**Table 2.** Number and percentages of study participants according to sex, laterality of the eye and categories of visual acuity.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Laterality** | Boys | | Girls | | Total | | p value\* |
|  | n | % | n | % | n | % |
| **Right eye** |  |  |  |  |  |  |  |
| Normal | 4121 | 94.4 | 4349 | 95.3 | 8470 | 94.8 | 0.035 |
| Mild VI | 84 | 1.9 | 132 | 2.9 | 216 | 2.4 |
| Moderate VI | 134 | 3.1 | 68 | 1.5 | 202 | 2.3 |
| Severe VI | 10 | 0.2 | 11 | 0.2 | 21 | 0.3 |
| Blindness | 17 | 0.4 | 4 | 0.1 | 21 | 0.2 |
| **Total** | **4366** | **100.0** | **4564** | **100.0** | **8930** | **100.0** |
| **Left eye** |  | |  | |  |  | 0.031 |
| Normal | 4135 | 94.7 | 4372 | 95.8 | 8507 | 95.3 |
| Mild VI | 84 | 1.9 | 118 | 2.6 | 202 | 2.3 |
| Moderate VI | 127 | 2.9 | 57 | 1.2 | 184 | 2.1 |
| Severe VI | 11 | 0.3 | 8 | 0.2 | 19 | 0.2 |
| Blindness | 9 | 0.2 | 9 | 0.2 | 18 | 0.2 |
| **Total** | **4366** | **100.0** | **4564** | **100.0** | **8930** | **100.0** |  |

n: number; %: percentage;

\* The results of Chi-square assessment

Of the 4564 girls in this study, 211 (4.6%) had VI and 4 (0.1%) had blindness in their right eyes. For the left eye, 183 (4.0%) had VI, and 9 (0.2%) had blindness in their left eyes.

**Causes of visual impairment and blindness**

Of the 460 schoolchildren with VI&B in their worse eye (right eye), 334 (72.6%) had a type of refractive error, while 126 (27.4%) were suffering from other visual threatening diseases. **Table 3** displays the number and percentages of study participants according to the causes of VI&B.

**Table 3.** Number and percentages of participants according to the causes of VI and blindness

|  |  |  |  |
| --- | --- | --- | --- |
| **Causes of visual impairment and blindness** | **n** | **%\*** | **%**† |
| **Refractive error causes** |  |  |  |
| Mild myopia | 136 | 29.6 | 1.5 |
| Moderate myopia | 64 | 13.9 | 0.7 |
| High myopia | 3 | 0.7 | 0.0 |
| Mild hyperopia | 34 | 7.4 | 0.4 |
| Moderate hyperopia | 10 | 2.2 | 0.1 |
| Astigmatism | 22 | 4.8 | 0.2 |
| Myopic astigmatism | 31 | 6.7 | 0.3 |
| Hyperopic astigmatism | 34 | 7.4 | 0.4 |
| **Non-refractive error causes** |  |  |  |
| Strabismus | 45 | 9.8 | 0.5 |
| Amblyopia | 31 | 6.7 | 0.3 |
| Cataract | 7 | 1.5 | 0.1 |
| Trauma | 6 | 1.3 | 0.1 |
| Glaucoma | 2 | 0.4 | 0.0 |
| Corneal opacity | 1 | 0.2 | 0.0 |
| Others | 34 | 7.4 | 0.4 |
| **Total** | **460** | **100.0** | **5.2** |

n: number

\* percentage calculated from participants with visual impairment and blindness

† percentage of calculated from all study participants

**Accompanying signs and symptoms**

**Table 4** displays the accompanying signs and symptoms of participants with VI&B. Ocular itching was the most prevalent (30.7%) and dryness was the least prevalent (0.9%) symptoms.

**DISCUSSION**

This study assessed the prevalence and causes of VI&B among primary schoolchildren in Herat, Afghanistan. VI&B are uncommon in children compared to adults; however, they may lead to significant social, economic, and public health disabilities in adult age (World Health Organization, 2021a). Therefore, knowledge about magnitude and etiology of VI&B in a community is essential for a proper and timely management of these diseases.

**Table 4.** Accompanying clinical presentations in study participants with VI and blindness

|  |  |  |
| --- | --- | --- |
| Signs and symptoms | n | %\* |
| Itching | 141 | 30.7 |
| Burning | 133 | 28.9 |
| Headache | 54 | 11.7 |
| Ocular Pain | 22 | 4.8 |
| Photophobia | 14 | 3.0 |
| Dry Eye | 4 | 0.9 |

n: number; %: percentage

\* Percentage calculated from participants with VI and blindness

This study found that the overall prevalence of VI was 4.9% in the right eye and 4.6% in the left eye. This finding is in alignment with the results of similar studies from India (5.9%, 5.0%) and Ethiopia (5.3%; Abayo et al., 2021; Dandona et al., 2002; Wadhwani et al., 2021); slightly higher than that of Ethiopia (3.5% and 3.9%), Malaysia (3.5%), Iran (3.8%), Nepal (2.9%), South Africa (2.7%), and Kenya (2.4%; Bezabih et al., 2017; Farhana and Rahim n.d.; Fotouhi et al., 2007; Kedir and Girma 2014; Muma and Obonyo 2020; Naidoo et al., 2003; Pokharel et al., 2000); but significantly lower than that of Malaysia (17.1%), Chile (15.8%), China (12.8%, 12.2% and 7.7%), Denmark (10.50%), India (9.0%), and Ethiopia (8.7% and 8.0%; Cui et al., 2021; Goh et al., 2005; Maul et al., 2000; Merrie et al., 2019; Murthy et al., 2002; Pi et al., 2012; Sandfeld et al., 2007; Zelalem et al., 2019; Zhao et al., 2000).The variation in the prevalence of VI between different studies may be attributed to several factors, such as study design, and population characteristics including ethnicity, socioeconomic and access to healthcare facilities (Pi et al., 2012).

Our results also show that the prevalence of blindness was 0.2% in the right eye and 0.2% in the left eye. This is unlike the results of similar studies conducted in Ethiopia (1.6% and 1.1%) and India (0.4%) with a higher prevalence of blindness in their study population (Berhane et al., 2008; Wadhwani et al., 2021; Zelalem et al., 2019).

This study revealed a significant association between VA and the age of study participants. This is consistent with similar studies conducted in Ethiopia, China, the USA, and Somalia, (Ahmed et al., 2020; Pi et al., 2012; Tarczy-Hornoch et al., 2013; Zelalem et al., 2019). Similarly, the association between VA and the sex of the study participants was significant in this study. This is similar to the findings of studies in Ethiopia (Bezabih et al., 2017). However, it is in contradiction to the findings of several studies that reported an insignificant association between VA and the sex of schoolchildren (Ahmed et al., 2020; Pi et al., 2012; Zelalem et al., 2019).

Our results also revealed a significant association between prevalence of VI&B and the grades in which schoolchildren studied. This finding is in line with a Nigerian study in which significant difference was observed in distribution of VI&B across classes (Ezegwui et al., 2021).However, a study from Somalia found no significant association between VI&B across classes of schoolchildren (Ahmed et al., 2020).The difference between our results and findings of some relevant studies may be attributed to study design, sample size, definition of VI&B and population characteristics.

This study showed that refractive error was the cause of VI&B in approximately three-quarters of cases (72.6%). This is similar to the findings of studies from China (78.0%), Somalia (76.8%), Brazil (76.8%), India (75.7%; Ahmed et al., 2020; Cui et al., 2021; Salomao et al., 2008; Wadhwani et al., 2021); but significantly lower than other similar studies from Bhutan (94.20%), Nepal (93.3%), Malaysia (92.2%), and China (89.48%, 86.08%; Farhana & Rahim n.d.; He et al., 2014; Pi et al., 2012; Sapkota et al., 2008; Sharma et al., 2020). However, studies from Kenya (62.0%), Malaysia (47.7%), and Nigeria (33.3%) reported a considerably lower prevalence of refractive error among visually-impaired study participants (Ezegwui et al., 2021; Farhana & Rahim n.d.; Muma & Obonyo, 2020).Among sampled population, the overall prevalence of refractive error in this study was 3.6%, which is consistent with the 3.4% prevalence of refractive error in Nigeria, (Maduka-Okafor et al., 2021), higher than 2.1% reported from Nigeria (Ezegwui et al., 2021),but considerably lower than 4.6% reported from Brazil (Salomao et al., 2008).Of different types of refractive error in our sampled population, myopia accounted for most cases (2.2%), astigmatism for 0.9% and hyperopia for 0.5%.

The overall 5.2% VI&B in this study highlights its significance as a public health issue in Herat city as the study location and Afghanistan as a whole. Data suggests that immediate, timely and appropriate interventions are required to tackle this phenomenon in the country. Given the considerable impact VI&B has on economy, and the fact that Afghanistan is defined as a low-to-middle income country, (World Bank, 2021) it is strictly recommended that all eye care efforts are coordinated via the National Eye Care Committee and the Ministry of Public Health.

**Study strengths**

This study recruited 8930 schoolchildren of Herat, Afghanistan. This is the first study to conduct a comprehensive assessment of the prevalence and causes of VI&B in Afghanistan. Data from this study provides information for policymakers and eye care practitioners to develop and implement strategies to reduce the burden of VI&B and lessen their impact on health and economy of the country in the future.

**Study limitations**

This study was conducted only among primary schoolchildren. It is advisable to conduct similar research among high schoolchildren as well, to better identify the prevalence and causes of VI&B among schoolchildren as a whole. Moreover, this descriptive study did not take into account the relationship and/or the impact of sociodemographic, cultural and behavioral factors on VA and VI&B of study participants. Future research may address this gap.

**Conclusion**

The prevalence of VI&B among schoolchildren in Herat is high, and the principle cause was uncorrected refractive error. Given the considerable social, economic and health impact VI&B can put on children life in adult age; public health, eye care authorities and policymakers should design and implement strategies to reduce the burden of this disease in our community.

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The funding agency had no role in the study design, data analysis, preparation of the manuscript and decision to publish.

**Conflict of Interest**

The authors declare that there is no conflict of interest.

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