

Prevalence of Visual Impairment Among Primary School Pupils in the Ga West Municipality, Ghana

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Abstract

Objective: To determine the prevalence and pattern of visual impairment (VI) among primary school pupils in the Ga West Municipality of Ghana. **Methods:** A descriptive cross-sectional survey among primary school pupils at the Ga West Municipality. A cluster sampling technique was used to select 765 pupils from 12 primary schools (six public and six private schools). All pupils had presenting visual acuity (VA) testing and pupils with VI (presenting VA <6/18 in the better eye) had detailed ocular examination to determine the cause of VI. Binary logistic regression was used to determine the association between independent variables and prevalence of VI. **Results:** Four hundred and forty-eight (58.6%) of the pupils were males and their mean age was 10 ± 2.4 years. The prevalence of VI was 4.3%. Refractive error, 17 (51.5%), was the most common cause of moderate VI. Other morbidities associated with moderate VI were ocular surface abnormalities secondary to vernal keratoconjunctivitis, five (15.2%), amblyopia, four (12.1%), cataract, two (6.1%), and albinism, two (6.1%). The causes of severe VI were corneal opacity, chorioretinal scars, and glaucoma, each accounting for 3.0% of VI. Increasing age of pupils ($P = 0.04$) and private school attendance ($P = 0.01$) were found to be significantly associated with a higher prevalence of VI. **Conclusion:** Refractive error was the most common cause of VI in the primary school pupils. Annual eye examination and provision of affordable spectacles to school pupils with refractive error is recommended to reduce the impact of VI on their educational achievement.

Keywords: Ga West Municipality, primary school pupils, refractive error, school eye health, vision impairment

INTRODUCTION

Visual impairment (VI) in childhood is a worldwide problem and has significant impact on pupils' education, personal development, and economic productivity.^[1] Childhood blindness is a priority because of the number of years of blindness that ensues.^[2] There is a wide regional variation in the burden and causes of blindness in children.^[2] The prevalence of blindness in children varies from approximately 0.3 per 1,000 children in high-income countries, to 1.2 per 1,000 in low-income countries.^[2] The major causes of blindness and VI in children include uncorrected refractive errors, trachoma, vitamin A deficiency-related disorders, amblyopia, cataract, and retinopathy of prematurity.^[2]

Eye health is an integral part of school health. It has been recommended that all primary school children should have eye test to detect reduced visual acuity (VA) followed by annual eye screening for new primary school pupils and for

those wearing spectacles to maintain correct prescriptions.^[3] In a descriptive cross-sectional study of the awareness and perception of stakeholders regarding preschool vision screening in the Kumasi Metropolis of Ghana, Akuffo *et al.*^[4] observed that 74% of respondents reported absence of preschool vision screening and 90% reported no written policies on preschool vision screening in schools.

Studies on VI in Ghana are varied in terms of definition of VI, age category, school ownership, and ocular morbidities investigated.^[5-8] Ovenseri-Ogbomo and Omuemu^[5] and Kumah *et al.*^[6] reported on the prevalence of refractive

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errors and its contribution to VI among school children. The prevalence of low vision and blindness in children aged between 5 and 19 years was 0.9% and 0.1%, respectively, in the study by Ovenseri-Ogbomo and Omuemu.^[5] Kumah *et al.*^[6] reported a prevalence of VI of 2.5%, and refractive error was the most predominant ocular morbidity followed by allergic conjunctivitis. The study by Kumah *et al.*^[6] was limited to children aged between 12 and 15 years in private schools in the Ashanti Region. On the other hand, Abu *et al.*^[7] reported on ocular disorders and VI among junior high school pupils aged between 9 and 22 years in the Cape Coast Metropolis. The prevalence of VI was 4.6% and refractive error was the most common cause of VI. Nartey *et al.*^[8] observed that 27.3% of school children had ocular anomalies in public primary schools in Ashaiman, Accra. In this study, we report the pattern and prevalence of VI among primary school children in both public and private schools in the Ga West Municipality of the Greater Accra region.

MATERIALS AND METHODS

A Descriptive cross-sectional survey was used to investigate the prevalence and pattern of VI among primary school pupils of the Ga West Municipality between August 8, 2016 and November 4, 2016. The study protocol was approved by the Ethical and Protocol Review Committee of the College of Health Sciences, University of Ghana (CHS-Et/M.10-P 4.3/2015-2016) and the study adhered to the tenets of the Declaration of Helsinki. Permission was obtained from the Ghana Education Service and the heads of the participating schools. Consent was obtained from parents/guardians of each participating school pupil.

The population of the Ga West Municipality is youthful with 33.4% of the population aged below 15 years. Of the population aged 3 years and older in the Municipality, less than two-fifth (37.4%) were currently attending school.^[9] Of those attending school, 13.8% were in Kindergarten, 41.3% in primary schools, and 17.7% in Junior High Schools.^[9] At the time of the conduct of this study, there were 12 educational circuits, 274 primary schools, and 23,637 and 26,557 pupils in the public and private schools, respectively. There were no

integrated primary schools for the visually impaired in the Ga West Municipality.

SAMPLE SELECTION

The inclusion criteria were all pupils irrespective of age whose guardians/parents consented for them to participate in the study as well as assent from the pupils. Pupils with developmental delay which could affect visual assessment were excluded from the study. Pupils enrolled in the study who for any reason were absent from school on the day of the examination were excluded from the study and replaced by the next pupil in the class register.

The adjusted minimum sample size was 720 pupils from both private and public schools. Sample size calculation was based on the formula $N = Z * Z * P (1 - P) / D * D$, where N = required minimum sample size, Z = confidence level, that is, 1.96, P = anticipated prevalence of VI among school children, D = degree of accuracy desired, that is, 0.05. Assuming prevalence of ocular anomalies and VI among school children aged between 6 and 15 years of 25%,^[8,10] considering a response rate of 80%, and 100% sample defect associated with cluster sampling (design effect of 2), the minimum required sample size was 720. However, in the recruitment of participants, a total of 765 students were selected for the study based on proportional allocation to the population size of the schools.

A sampling frame consisting of the list of schools was obtained from the Educational Directorate of the Ga West Municipal Assembly. The municipality is divided into 12 clusters of educational circuits by the Ghana Education Service with a total of 73 public primary schools and 201 private primary schools. Each circuit had a total of 23 schools. Six circuits were selected by cluster sampling technique with the help of random number generator in Microsoft Excel 2010 software. The schools were grouped into public and private schools, respectively. A public and a private school was selected from each of the six selected circuits to have a total of 12 participating schools in the Municipality. Simple random sampling was used in selecting the schools from each of the six selected circuits. The total population of

Table 1: Selection of participants

Public school	No. of students (N)	Sampling ratio (R)	No. sampled from school (N × R)	Private school	No. of students (N)	Sampling ratio (R)	No. sampled from school (N × R)
1	270	0.268	72	1	210	0.261	55
2	256	0.268	69	2	208	0.261	54
3	280	0.268	75	3	215	0.261	56
4	260	0.268	70	4	240	0.261	63
5	242	0.268	65	5	236	0.261	62
6	265	0.268	71	6	205	0.261	53
Total	1573		422	Total	1314		343

N, number.

the six public and private schools selected was 1586 and 1314, respectively.

The population of the various schools selected is presented in Table 1. Proportional allocation to the population size of the schools was used. This is also illustrated in Table 1.

A sampling ratio was derived by dividing the sample size by the total number of pupils in all the 12 selected schools according to the type of school. The sampling ratio was then multiplied by the number of students in each school to obtain the number sampled from each school.

In selecting the number sampled from each class, the total number of students in each class was divided by the total number of students in that particular school. The outcome was then multiplied by the number to be sampled from the school to obtain the total number that was sampled from each class (proportional allocation to the size of each class). This was done for all the schools.

At the final stage, simple random sampling was used again in selecting participants in each class for each school. Each name in the class register was assigned a number and listed on a Microsoft Excel 2010 worksheet. The random number generator command was used in randomizing the names on the list. The name which appeared first was selected, followed by the next name in an orderly manner until the total number to be selected was obtained for each class.

STUDY DEFINITIONS

Normal VA (mild or no VI) was defined as presenting VA equal to or better than 6/18.^[11] Moderate VI was defined as presenting VA worse than 6/18 but better than or equal to 6/60, and severe VI was VA worse than 6/60 but better than or equal to 3/60. Blindness was defined as presenting VA worse than 3/60. Refractive error as a cause of VI was defined as presenting VA in the better eye worse than 6/18 which improved on pinhole acuity test. Amblyopia diagnosed if there was VI and no structural anomaly was detected as a cause of the VI on ocular examination. A suspicion of glaucoma was made if one of the following clinical characteristics was observed: buphthalmos, Haab striae, or suspicious disc appearance for glaucoma. A diagnosis of glaucoma was made if there is suspicion for glaucoma during initial eye examination in addition to the following findings; history of previous glaucoma surgery or presence of two or more of the following criteria^[12]:

- (i) corneal findings: Haab striae or corneal diameter >13 mm
- (ii) intraocular pressure: >21 mm Hg
- (iii) optic disc cupping: cup–disc asymmetry of ≥ 0.2 when the discs are similar size, focal rim thinning, or progressive increase in cup–disc ratio
- (iv) reproducible visual field defect that is consistent with glaucomatous optic neuropathy with no other observable reason for the visual field defect.

CLINICAL PROCEDURES

Instruments required included Snellen chart, Ishihara chart, pen torches, a 6 m tape measure, a direct ophthalmoscope (HEINE Optotechnik GmbH & Co. KG, Gilching, Germany), applanation tonometer, dark curtains, stationery, and the following drugs: tropicamide 0.8% + phenylephrine 5% – used for pupillary dilatation before fundoscopy. Presenting VA and eye examination was performed by a senior resident in ophthalmology (W.C.). VA of all the sampled pupils in the schools were tested by the principal investigator (W.C.) using the Snellen chart at a distance of 6 m in the classrooms or on the corridors in broad daylight. First, the right eye was tested while occluding the fellow eye followed by the left eye. Pupils presenting with VA of 6/18 or better in the better eye were given free treatment for simple ailments where necessary but were excluded from the rest of the examination procedures. The principal investigator performed a detailed examination of pupils whose presenting VA was worse than 6/18 in the better eye. The detailed examination included VA with pinhole, external ocular examination by use of pen torch, fundoscopy by use of a direct ophthalmoscope (after the eyes of each school pupil was dilated using tropicamide 0.8% + phenylephrine 5% drops and examined in a darkened corner of the classroom). Refraction was not done due to logistical constraints. Causes of VI were established by eye examination of the respondents using standard procedures, equipment, and respondent's medical history.

STATISTICAL ANALYSIS

The collected data was entered into a database designed in Microsoft Access 2010 and IBM SPSS, IBM, Armonk, New York, United States version 20.0 was used for data analysis. The dependent variable in this study was prevalence of VI and the independent variables were age category, sex, class category, and school type. Descriptive statistics such as percentages, means, and standard deviations were used to describe and summarize the data. The binary logistic regression model was used to test the association of age, sex, school type, and class category with the prevalence of VI. *P*-value < 0.05 was considered statistically significant.

RESULTS

There were a total of 765 pupils in the study drawn from six public and six private schools, out of which 448 (58.6%) were boys and 317 (41.4%) were girls [Table 2]. The mean age of the student population was 10 ± 2.36 years while the median and modal ages were both 10 years, with a range of 6 to 18 years. The age group most represented was 8 to 11 years with 401 (52.4%) pupils and the least represented was 16 years and above with 14 (1.8%) pupils. The classes were divided into lower primary (class 1–3) and upper primary (class 4–6) with majority of the respondents, 415 (54.3%), in the upper primary category [Table 2]. There were more students

Table 2: Age, class, and sex distribution of pupils

Age group (years)	Sex		Total <i>N</i> (%)
	Female <i>N</i> (%)	Male <i>N</i> (%)	
≤7	29 (3.8)	44 (5.7)	73 (9.5)
8–11	167 (21.8)	234 (30.6)	401 (52.4)
12–15	115 (15.0)	162 (21.2)	277 (36.2)
≥16	6 (0.8)	8 (1.1)	14 (1.8)
Total	317 (41.4)	448 (58.6)	765 (100.0)
Class			
Lower primary (class 1–3)	151 (19.7)	199 (26.0)	350 (45.7)
Upper primary (class 4–6)	166 (21.7)	249 (32.6)	415 (54.3)
Total	317 (41.4)	448 (58.6)	765 (100.0)

N, number.

Table 3: Patterns of visual impairment among primary school pupils

Demographic characteristics Parameter	NV (%)	Classification of visual impairment		Total (%)
		MVI (%)	SVI (%)	
Sex				
Female	302 (39.5)	12 (1.6)	3 (0.4)	317 (41.4)
Male	430 (56.2)	18 (2.4)	–	448 (58.6)
Total	732 (95.7)	30 (3.9)	3 (0.4)	765 (100.0)
Age group				
≤7	72 (9.4)	1 (0.1)	–	73 (9.5)
8–11	383 (50.1)	15 (2.0)	3 (0.4)	401 (52.4)
12–15	265 (34.6)	12 (1.6)	–	277 (36.2)
≥16	12 (1.6)	2 (0.3)	–	14 (1.8)
Total	732 (95.7)	30 (3.9)	3 (0.4)	765 (100.0)
Class				
Lower primary	337 (44.1)	11 (1.4)	2 (0.3)	350 (45.8)
Upper primary	395 (51.6)	19 (2.5)	1 (0.1)	415 (54.2)
Total	732 (95.7)	30 (3.9)	3 (0.4)	765 (100.0)
Type of school				
Public school	408 (53.3)	12 (1.6)	2 (0.3)	422 (55.2)
Private school	324 (42.4)	18 (2.3)	1 (0.1)	343 (44.8)
Total	732 (95.7)	30 (3.9)	3 (0.4)	765 (100.0)

MVI, moderate visual impairment; NV, normal vision; SVI, severe visual impairment.

examined in the public than private schools, 422 (55.2%) compared to 343 (44.8%). There were more pupils in the lower primary of the private schools, 210 (60.0%), than in the public school 140 (40.0%), and in the upper primary of the public schools, 282 (68.0%), compared to the private schools 133 (32.0%).

The pattern of VI among age category, gender, class category, and type of school is as shown in Table 3. The prevalence of VI (moderate + severe) was 4.3%. The 8 to 11 years age group was most affected by VI, 18 (2.4%) followed by 12 to 15 years 12 (1.6%). While the 7 years and younger age group was least affected, only 1 (0.1%) [Table 4]. More males were visually impaired, 18 (2.4%), than females, 15 (2.0%) [Table 4]. There were more visually impaired pupils in the upper primary, 20 (2.6%), when compared to the lower

Table 4: Risk factors for visual impairment among primary school pupils

Factors	OR	95% CI	<i>P</i> -value
Age (in years)	1.25	1.01–1.56	0.039*
Sex:	Ref.		
Female	0.82	0.4–1.66	0.577
Male			
School type:	Ref.		
Public	3.08	1.3–7.3	0.010*
Private			
Class:	Ref.		
Lower primary	0.89	0.35–2.27	0.809
Upper primary			

CI, confidence interval; OR, odds ratio. **P*-value < 0.05.

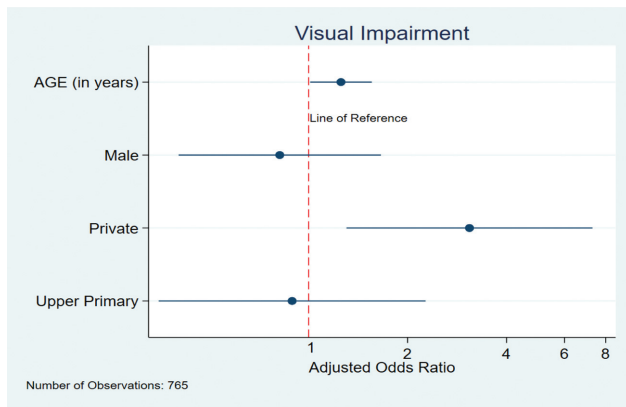


Figure 1: Effect of age, sex, type of school ownership, and class category on visual impairment in primary school children.

Table 5: Ocular morbidities in eyes with visual impairment

Cause	Frequency	Percentage (%)
Moderate visual impairment (30)		
Refractive errors	17	51.5
Ocular surface abnormality (VKC)	5	15.2
Amblyopia	4	12.1
Albinism	2	6.1
Cataract	2	6.1
Severe visual impairment (3)		
Corneal opacity	1	3.0
Chorioretinal scars	1	3.0
Glaucoma	1	3.0
Total	33	100

VKC, vernal keratoconjunctivitis.

primary, 13 (1.7%), while the private schools had a higher number, 19 (2.4%), of VI than public, 14 (1.9%). The three severely visually impaired were in the 8 to 11 year age group and they were all females. None of the primary school children were found to be blind.

From the binary logistic regression model, age and type of school were associated with VI ($P < 0.05$). The odds of having VI was three times higher among children from private schools compared to those from the public schools (odds ratio, OR: 3.08; 95% confidence interval, 95% CI: 1.30–7.30). With regards to age of the student, each year advancement in age was associated with 25% increase in the odds of developing VI (OR: 1.25, 95% CI: 1.01–1.56). There were not enough statistical evidence to show that sex and class level of the students were associated with VI ($P > 0.05$). Details of the associations are shown in Table 4 and Figure 1.

Refractive error, 17 (51.5%), was the most common cause of VI, which was diagnosed by the improvement of visual acuity with pinhole. Refraction was not done to determine the type of refractive error. Four pupils had amblyopia; one had bilateral pseudophakia with nystagmus, another had

strabismic amblyopia, and the other two had ametropic amblyopia [Table 5]. The causes of severe VI were corneal opacity, chorioretinal scars, and glaucoma, each accounting for 3.0% of VI [Table 5].

DISCUSSION

The prevalence of VI of 4.3% can be categorized as moderate and severe VI (MSVI) based on the definition of VI adopted in this study. The prevalence of presenting MSVI in this study is higher than the global estimates of VI (0.9%) in children below 15 years of age.^[13] Our study was, however, limited to children in primary schools in a low to middle income country. There is significant regional variation in the prevalence of VI and blindness. High-income countries tend to have a lower prevalence of VI and blindness compared to low-income countries.^[2] The high prevalence of presenting VI in primary school children in this study is supported by other cross-sectional studies conducted in sub-Saharan Africa with some variations.^[5-8,14-16] Previous studies of the prevalence of VI in Ghana have reported rates of between 1.0% and 4.6%.^[5-8] Ekpenyong *et al.*^[14] reported a prevalence of VI of 7.3% among school-aged children in Southern Nigeria based on presenting visual acuity of 6/12 or worse in the better eye. Muma and Obonyo^[15] reported a mean prevalence of VI of 1.7% based on pinhole acuity worse than 6/18 and 2.4% based on presenting visual acuity worse than 6/18. The variations in prevalence of VI can be attributed to differences in the definition of VI, age category of the children, and school type studied.

No primary school child was found to be blind in this study. It has been observed that children who are blind are likely to stay at home due to stigmatization.^[17] There is the need to increase awareness of the Government of Ghana inclusive education policy which emphasizes equitable access to education for all including children with special needs. The implementation of the inclusive education policy will reduce stigmatization as it promotes participation, friendship, and interaction.

Uncorrected refractive error is the leading cause of VI in school children globally.^[18] There are regional variations in the prevalence of refractive errors with the highest burden reported in Asia.^[18] Refractive error has been observed as the commonest cause of VI in school children in sub-Saharan Africa including our study. Although our definition of VI was based on presenting vision (thus excluded children whose impairment was adequately corrected with glasses), uncorrected or inadequately corrected refractive error was still the commonest cause of VI in our study. Presenting vision is a more accurate indicator of the burden of VI and quantify the need for services to reduce VI as a public health problem.^[18] The integration of vision screening and refractive error services in school health programs will reduce the impact of VI on the academic and social development of the school children.^[3]

Amblyopia is the second commonest cause of VI in this study. Amblyopia can affect normal visual development resulting in irreversible blindness. Early detection of conditions that affect normal visual development such as strabismus, refractive errors, and media opacities, and timely interventions will minimize the impact of amblyopia on the school performance.^[1] Vision screening prior to school entry can detect children with these amblyogenic factors.^[19] Akuffo *et al.*^[4] has reported on the nonexistence of preschool vision screening in Ghana.

There is a major decline in the burden of VI from infections such as trachoma and measles, and vitamin A-related visual disorders due to implementation of effective public health interventions across sub-Saharan Africa.^[13] Corneal opacity as a cause of VI was detected in only one child in this study supporting the positive impact of our expanded program of immunization.

The presence of VI in school children may be significantly associated with increasing age,^[14,15] high socioeconomic status,^[14,20] private schools,^[20] and female gender.^[14,20] Other studies did not find significant association between age, socioeconomic status, school type, and gender.^[7,21] Increasing age and private school type were significantly associated with VI in primary school children in our study. The association of VI with increasing age may be due to increasing prevalence of uncorrected refractive error with age. Muma and Obonyo^[15] observed increased prevalence of VI with increasing age and uncorrected refractive error was the main cause of VI among the children. Also, the higher prevalence of VI among children attending private schools may be attributed to differences in socioeconomic status. There is the tendency for children from higher socioeconomic status to attend private schools with more time spent on near work due to emphasis on academic performance and less time spent on outdoor activities.^[20] These factors have been found to be associated with myopia development.^[20] The inclusion of annual eye examination as part of school health program in both public and private school will help in early detection and timely treatment of children with visual problems to reduce the impact of VI on their development. However, gender and class category were not significantly associated with VI in primary school children in our study.

The main limitation of this study is that pupils who passed the vision screening were not examined, hence those with nonvisual impairing eye conditions or mild VI due to low refractive errors, color vision defects, and unocular pathologies could have been missed. Another major limitation is the fact that refraction was not done and refractive error was diagnosed based on improvement in visual acuity using pinhole acuity test. This might have resulted in misclassification of pupils with refractive error and amblyopia, thereby affecting the reported proportions of these ocular morbidities in this study.

CONCLUSION

The prevalence of VI was found to be 4.3%. The major causes of VI were uncorrected refractive errors and corneal complications of vernal keratoconjunctivitis. These findings underscore the need to establish a school eye health screening program for the early detection and timely management of these avoidable conditions. This will ultimately prevent or minimize the occurrence of preventable ocular morbidities among pupils in the municipality. Findings from this study highlight the need for preschool vision screening and integration of eye health in school health programs and implementation of inclusive education in primary schools in the Ga West Municipality of Ghana.

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Conflicts of interest

There are no conflicts of interest.

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