

# Prevalence of Refractive Errors among School Children Aged 5 to 15 Years Old at CHU-IOTA

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## Abstract

**Introduction:** Undetected refractive errors constitute a health problem among school children who cannot take advantage of educational opportunities. The authors studied the prevalence of refractive errors in school children aged 5 to 15 at CHU-IOTA. **Patients and Method:** This is a prospective, descriptive cross-sectional study carried out in the ophthalmic-pediatrics department of CHU-IOTA, from October to November 2023. **Results:** We received 340 school children aged 5 to 15, among whom 111 presented ametropia, *i.e.* a prevalence of 32.65%. The average age was  $11.42 \pm 2.75$  years and a sex ratio of 0.59. The average visual acuity was 4/10 (range 1/10 and 10/10). We found refractive defects: astigmatism 73.87%, hyperopia 23.87% of cases and myopia 2.25%. The decline in distance visual acuity was the most common functional sign. Ocular abnormalities associated with ametropia were dominated by allergic conjunctivitis (26.13%) and papillary excavation (6.31%) in astigmatics; allergic conjunctivitis (9.01%) and papillary excavation (7.20%) in hyperopic patients; turbid vitreous (0.90%), myopic choroidosis (0.45%) and allergic conjunctivitis (0.45%) in myopes. **Conclusion:** Refractive errors constitute a reality and a major public health problem among school children.

## Keywords

Refractive Errors, Prevalence, Child, CHU-IOTA

## 1. Introduction

Ametropia (refractive errors) constitutes a public health problem in children and adolescents due to the direct handicap they can cause but also due to the psycho-affective repercussions associated with it [1]. They are the most frequent reasons for consultation. It varies from 2% to 30% depending on the age group, the geographical region and the examination method [2].

They are recognized as one of the most important causes of correctable visual disturbances [1].

They are today the main cause of vision problems and among the major causes of blindness in the world [3].

According to the WHO, there are approximately 123.7 million uncorrected refractive errors and 826 million untreated presbyopias [4].

The overall magnitude of refractive error is not known with certainty, as there is wide variation in groups depending on age, definitions of blindness, and methods of examination. Proper correction prevents the development of amblyopia and allows for greater success in school [1].

In Africa, studies have been carried out on ametropia.

In the Democratic Republic of the Congo, Paluku *et al.* [5] found a frequency of ametropia at 11.47% and Michel *et al.* [6] at 13.5% in subjects aged 0 to 16 years.

In Mali, Diallo *et al.* found a prevalence of 11.3% of ametropia among lower-cycle students during a study carried out in lower-cycle schools in Sikasso [7].

At IOTA, Seydou [1] found a hospital frequency of refractive error of 46.8%; with astigmatism at 55.53%, hyperopia at 27.18% and myopia at 2.91% in children aged 5 to 18 years in his study carried out between January 2017 and February 2018 at CHU-IOTA.

However, data on the extent of refractive errors in schools in Sub-Saharan African countries are insufficient, hence the interest of this study. The objective of the present study was to determine the frequency and describe the most common refractive errors in school-age children and adolescents.

## 2. Patients and Methods

We conducted a prospective, descriptive cross-sectional study in the ophthalmic-pediatrics department of CHU-IOTA, from October to November 2023.

Study population: was school children aged 5 to 15 admitted for consultation at CHU-IOTA during the study period.

Inclusion criteria: included in our study were children aged 5 to 15 years presenting at least one ametropia in one of the eyes and whose parents have given their consent.

Non-inclusion criteria: were not included children not in school or the age is less than 5 years or more than 15 years, and whose parents have not given their consent.

Sampling: was of an exhaustive type in order to grant all school children aged 5 to 15 suffering from ametropia the same probability of participation.

This study was carried out as follows:

Census of the study population after validation and authorization to start the study;

Collection of sociodemographic information (sex, age, educational level, residence, etc.);

Ophthalmological examinations.

All participants had undergone a bilateral and comparative ophthalmological examination plan by plan based on:

Measuring visual acuity on the Monoyer scale and the Snellen E scale without optical correction and with the pinhole as well as with the correction if any existed;

Examination of the anterior segment with the slit lamp;

Taking intraocular pressure using a pulsed air tonometer;

Fundus examination using a direct ophthalmoscope.

After this ophthalmological examination, a systematic cycloplegic refraction was carried out using the following protocol:

Atropine: it was the first-line molecule unless contraindicated or refused by parents.

It is the same protocol regardless of age: 1 drop twice a day (morning and evening) for the 5 days before the consultation and the morning of the consultation.

- Between 5 and 8 years: atropine at 0.5%.
- After 8 years: 1% atropine.

Cyclopentolate 0.5%: second-line, in case of contraindication to atropine.

One drop at the start, another drop 5 minutes later and a 3rd drop 10 minutes later. The measurement will be carried out 45 minutes after the first instillation.

The refraction was done using automatic refractometry and/or skiascopy.

After this objective refraction, visual acuity was measured by the same scale before and ametropia was classified into myopia, hyperopia, astigmatism (simple and compound).

We end with the identification of ametropia after total optical correction.

The variables studied were epidemiological (age and sex), distance visual acuity at OD and OG, clinical data (reason for consultation, ocular pathology (appendages, anterior segment, posterior segment), types of ametropia (myopia, hyperopia, astigmatism).

Operational definitions:

Ametropias were defined in refractive values in:

- Myopia: low (less than  $-3$  diopters), medium (between  $-3$  and  $-6$  diopters), high (greater than  $-6$  diopters).
- Hyperopia: weak (less than  $+2$  diopters), medium (between  $+2$  and  $+5$  diopters), strong (greater than  $+5$  diopters).
- The axis of astigmatism was defined from 0 to 180 degrees.

Data collection support: a plugindividual survey completed from the patient

files was used for the collection of information.

Data collection technique: concerned the filling of survey sheets.

The survey sheets were anonymous. Consent from the parents of the students and from each student was requested for all participants and the opportunity was given to each participant to withdraw from the study without prejudice at any time.

Data management and analysis: the data collected were entered into Microsoft Word 2016 and Excel 2016 and analyzed using Epi info software version 7.2.5. They are expressed as absolute or relative value and average is increased by the standard deviation. Pearson's chi-square test (or Fisher's Exact where appropriate) was used to compare proportions. The statistical significance threshold was set at 5%.

Ethical considerations: all patients consented freely and in writing before enrollment. All rules of confidentiality and anonymity were respected. The study was approved by health authorities.

### 3. Results

#### Frequency:

During the period of our study, we received 340 school children aged 5 to 15 years in the ophthalmic-pediatrics department of CHU-IOTA, among whom 111 presented ametropia, *i.e.* a prevalence of 32.65%.

#### Sociodemographic characteristics:

The average age was  $11.42 \pm 2.75$  years and the most common was the age of 15 years or 18.02% followed by 12 years with a frequency of 17.12% (Figure 1). There were 70 girls (63.06%) and 41 boys (36.94%) for a sex ratio of 0.59 (Figure 2).

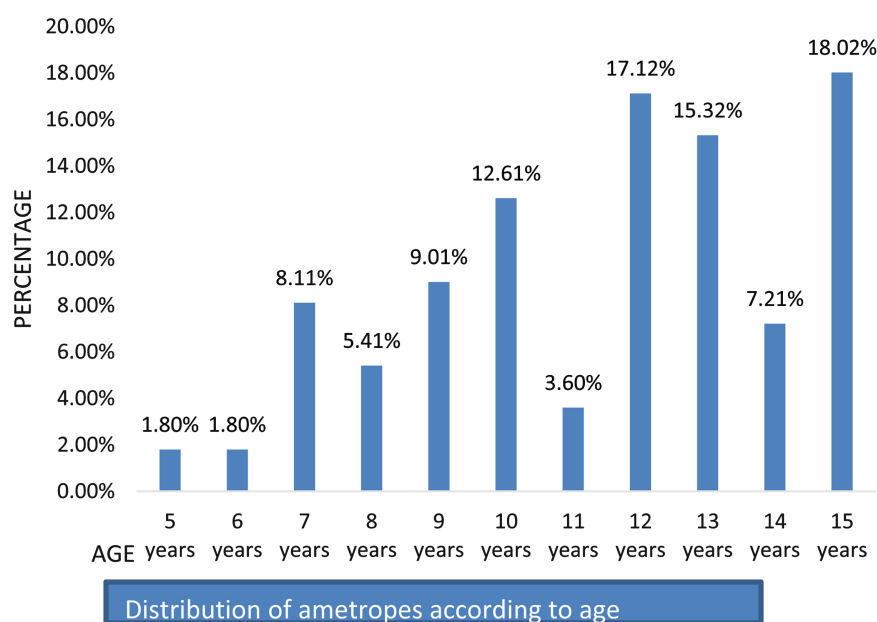
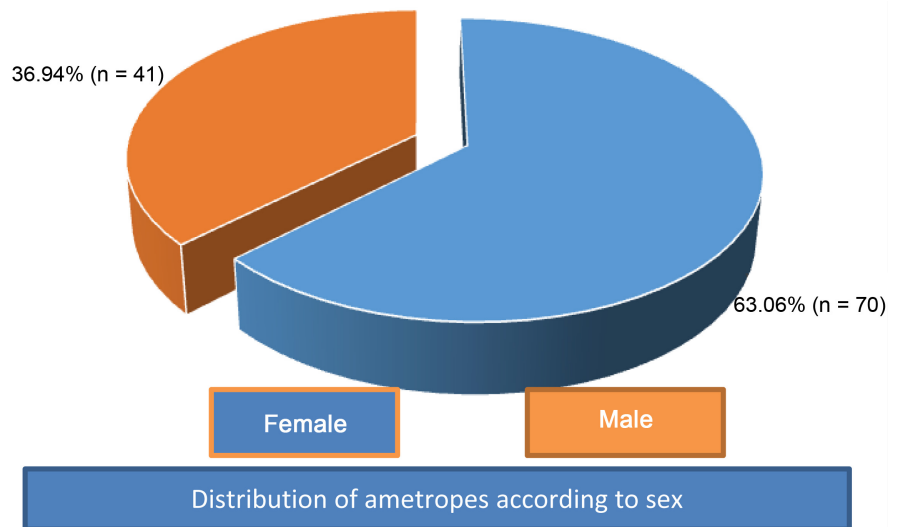


Figure 1. Distribution of ametropes according to age.



**Figure 2.** Distribution of ametropes according to sex.

**Clinical characteristics:**

The average visual acuity was 4/10 (range 1/10 and 10/10).

Intraocular pressure was normal in all patients. The refraction carried out by skiascopy and/or by automatic refractometry found as refractive defects: astigmatism 73.87%, hyperopia 23.87% of cases and myopia 2.25% (Table 1). The decrease in distance visual acuity was the functional sign, the most dominant, i.e. 76.58%, followed by ocular pain with 64.86% (Table 2). Ocular abnormalities associated with ametropia were dominated by allergic conjunctivitis (26.13%) and papillary excavation (6.31%) in astigmats; allergic conjunctivitis (9.01%) and papillary excavation (7.20%) in hyperopic patients; turbid vitreous (0.90%), myopic choroidosis (0.45%) and allergic conjunctivitis (0.45%) in myopes (Table 3).

**Refraction:**

Refractive errors were represented by astigmatism 73.87%, hyperopia 23.87% of cases and myopia 2.25% (Table 1).

Compound hyperopic astigmatism (43.90%) was the most represented of all astigmatisms followed by mixed hyperopic astigmatism (17.68%) (Table 4).

Astigmatism was direct (78.66%), inverse (10.37%) and oblique (10.98%) (Table 5).

Myopia was mild in 60% and severe in 40% of cases (Table 6).

**Table 1.** Distribution of ametropia according to type.

ODG refractive errors	Effective	Percentage
Hyperopia	53	23.87%
Myopia	5	2.25%
Astigmatism	164	73.87%
Total	222	100%

**Table 2.** Distribution of ametropes according to reason for consultation.

Complaints	Effective	
	Yes (%)	No (%)
BAV	85 (76.58%)	26 (23.42%)
Headache	43 (38.74%)	68 (61.26%)
Diplopia	5 (4.50%)	106 (95.50%)
Red eyes	3 (2.70%)	108 (97.30%)
Photophobia	51 (45.95%)	60 (54.05%)
Eye pain	72 (64.86%)	39 (35.14%)
Visual blur	44 (39.64%)	67 (60.36%)
Tearing	28 (25.23%)	83 (74.77%)
Pruritus	49 (44.14%)	62 (55.86%)
Visual fatigue	66 (59.46%)	45 (40.54%)
Other	6 (5.41%)	105 (94.59%)

**Table 3.** Distribution of the type of ametropia of the eyes according to the associated ocular anomalies.

Associated pathologies	Hyperopia not (%)	Myopia not (%)	Astigmatism not (%)
Papillary excavation	16 (7.20%)	0 (0%)	14 (6.31%)
Hypo pigmentation of EP	0 (0%)	0 (0%)	2 (0.90%)
Myopic choroidosis	0 (0%)	1 (0.45%)	3 (1.35%)
Chorioretinitis scar	0 (0%)	0 (0%)	2 (0.90%)
Papillary pallor	20.90%	0 (0%)	0 ((0%)
Retinitis pigmentosa	0 (0%)	0 (0%)	2 (0.90%)
Cloudy vitreous	0 (0%)	2 (0.90%)	0 (0%)
Corneal dystrophy	10.45%	0 (0%)	3 (1.35%)
Keratoconus	0 (0%)	0 (0%)	6 (2.70%)
Pseudophakia	0 (0%)	0 (0%)	2 (0.90%)
Megalocornea	0 (0%)	0 (0%)	2 (0.90%)
Allergic conjunctivitis	20 (9.01%)	1 (0.45%)	58 (26.13%)
Normal	14 (6.31%)	1 (0.45%)	70 (31.53%)
Total	53 (23.87%)	5 (2.25%)	164 (73.87%)

**Table 4.** Distribution of astigmatism according to the power of the two main meridians.

ASTIMATISM		
Power Astigmatism	Effective	Percentage
Simple hyperopia	19	11.59%
Compound hyperopic	72	43.90%
Mixed hyperopia	29	17.68%
Simple myopic	26	15.85%
Compound myopic	18	10.98%
Total	164	100%

**Table 5.** Distribution of astigmatism depending on the orientation of the main meridians.

ASTIMATISM		
KIND	Effective	Percentage
Direct	129	78.66%
Reverse	17	10.37%
Oblique	18	10.98%
Total	164	100%

**Table 6.** Distribution of myopia according to power.

MYOPIA		
Power	Effective	Percentage
Weak [<2D]	3	60.00%
Average [2 - 5D]	0	0.00%
Severe [≥7D]	2	40.00%
Total	5	100%

Hyperopia was low in 96.23% and average 3.77% of cases (**Table 7**).

**Table 7.** Distribution of hyperopia according to power.

HYPERMETROPIA		
Power	Effective	Percentage
Weak [<2D]	51	96.23%
Average [2 - 5D]	2	3.77%
Severe [≥6D]	0	0.00%
Total	53	100%

## 4. Comments and Discussions

### 4.1. Prevalence

Of 340 school children aged 5 to 15 examined at CHU-IOTA during the period from October 30 to November 18, 111 had at least one ametropia, representing an overall prevalence of 32.65%.

Similarly, Andre *et al.* [8] and Seydou at IOTA [1] found a respective prevalence of 43.1% and 46.8%.

Our frequency was much higher than that of Rakotoarisoa *et al.* [9], Auzemery

*et al.* [10], Sounouvou *et al.* [11], and Nepal *et al.* [12] who found respectively 13.5%, 2% - 10%, 10.6% and 8.1%.

On the other hand, prevalences higher than ours were reported by: Ezinne *et al.* [13] in Nigeria (86.6%), Domngang Noche *et al.* [14] in Cameroon (86.3%), He *et al.* [15] in Guangzhou in China (50.8%), Ayed *et al.* [16] in Tunisia (57.2%) and by Maul *et al.* [17] in Chile (56.3%).

This difference between our results and those of others can be explained by the difference in methodology on the one hand and by the variability depending on the type of study (hospital, school and population).

## 4.2. Sociodemographic Characteristics

### Age:

The average age was  $11.42 \pm 2.75$  years and the most common was the age of 15 years or 18.02% followed by 12 years with a frequency of 17.12%.

Leon [18] and Domngang Noche *et al.* [14] carried out their survey on the same age group as ours (5 to 15 years).

Andre *et al.* [8] studied the age group of 6 to 15 years.

The survey carried out by Barroso Schimiti *et al.* [19] focused on the age group of 6 to 12 years.

Ayed *et al.* [16] in Tunisia did a study on the age group from 6 to 20 years in 2000.

It is in this age group that refractive errors must be detected to avoid their repercussions on children's studies as much as possible.

According to the literature review, it should be noted that it is at the age of 6, more or less 3, that the child begins schooling, so he acquires many new things. This will affect his brain as well as the organ of sight. At the age of 15, the child's emmetropization process ends and, moreover, at this age, students have intense school activity [20].

### Sex:

We received 70 girls (63.06%) and 41 boys (36.94%) for a sex ratio of 0.59.

Our values are comparable to those found by Andre *et al.* [8] who found 60.7% of female ametropes compared to 39.3% of males.

On the other hand, Raharinantenaina [20] found 51.77% male versus 48.21% female and stipulated that there was no link between ametropia and sex.

## 4.3. Clinical Characteristics

The average visual acuity was 4/10 (range 1/10 and 10/10).

Intraocular pressure was normal in all patients.

These values are comparable to those of Seydou [1] whose average visual acuity was 5/10 (extreme of 1/10 and 10/10) as well as normal intraocular pressure in all patients.

The refractive errors found were:

Astigmatism 73.87%, hyperopia 23.87% of cases and myopia 2.25%.

In the present study, BAV was the most recurrent complaint in ametropes, *i.e.* 76.58%, followed by eye pain and visual fatigue, *i.e.* 64.86% and 59.46% respectively.

Frequencies lower than ours were reported by Seydou [1] and Paluku *et al.* [5], respectively 42.2% and 42.1% reduction in visual acuity and headaches represented 25% for the latter.

On the other hand, Diallo *et al.* [7] found 54.1% of patients without complaints compared to 7.1% of the drop in visual acuity and 1.9% of pruritus and affirms that the latter could be linked to the season of allergic conjunctivitis which was noticed during their studies.

These results show that reduced visual acuity is one of the main complaints that lead most patients to come for consultation.

Associated pathologies were found in 137 ametropic eyes or 61.7%.

Allergic conjunctivitis was the most common ocular pathology in hyperopia and astigmatism, respectively 9.01% and 26.13% followed by pathological papillary excavation in 7.2% and 6.31% respectively, on the other hand, the vitreous disorder was the most represented pathology of myopes among the 61.7%.

This result is close to that of Diallo *et al.* [7] who found 68.3% of associated pathology and affirmed that LCET was associated with different types of ametropia with 74.25% in myopes; 68.75% in hyperopia; 71.74% in astigmatism.

These results could be explained by the conjunctivitis season, which was prevalent during our studies.

Refraction:

Refractive errors were represented by astigmatism 73.87%, hyperopia 23.87% of cases and myopia 2.25%.

Astigmatism:

In our study, astigmatism was the most common ametropia with 73.87% (n = 164).

This prevalence is roughly similar to that of NWOSU. Nwosu *et al.* [21] who found 75.5% astigmatism in their series.

Other authors have reported prevalences lower than ours: Garcia *et al.* [22], and Kawuma *et al.* [23] who found 34% and 52% respectively.

On the other hand, a study carried out in Benin by Sounouvou *et al.* [11] found that 91.9% of ametropes were astigmatic.

We did not find a statistically significant difference between age, gender and astigmatism. 60.37% of astigmatics were female with a sex ratio of 0.66, among whom 20.12% were aged 15 years.

In the present study, 78.66% of astigmatisms were direct; 10.37% reverse and 10.98% oblique.

On the other hand, in the investigation carried out by Diallo *et al.* [7] astigmatism represented 46.5% among which 92.4% were direct astigmatisms; 4.6% were inverse and 3% were oblique.

Among our cases of astigmatism, 43.90% were compound hyperopic.

This high prevalence of astigmatism, especially among those aged 15, could be explained by the end of emmetropization at this age.

**Hyperopia:**

In our study, hyperopia was found in 23.87% (n = 53) of ametropes.

This frequency is similar to that of Andre *et al.* [8] who found 23.7%.

In Benin, Sounouvou *et al.* [11] found that 19.7% of ametropes were hyperopic.

In a study carried out in Iran, Hashemi *et al.* [24] reported 21.70% hyperopia.

Frequencies higher than ours were found by: Faderin *et al.* [25] which was 52.2%.

Low hyperopia represented 96.23% of hyperopia in our study.

**Myopia:**

Myopia was mild in 60% and severe in 40% of cases.

In our study, we found a prevalence of 2.25% (n = 5) for all female myopia, *i.e.* 100%. Ages 6 and 10 each represented 40% of myopes.

This prevalence of myopia is similar to that reported by Leon [18] which was 2.5%.

Proportions higher than ours were reported by Faderin *et al.* [25] and Diallo *et al.* [7] who found 9% and 38.7% of myopia, respectively.

Low myopia represented 60% of all myopes.

This diversity in prevalence between our results and the literature data can be explained on the one hand by environmental factors, which are accentuated in urban areas and attenuated in rural areas. On the other hand, the genetic factor is recognized in both small and high myopias. This heredity can be dominant or recessive in both cases. The relationship between age, gender and myopia is poorly understood [20].

One of the physiopathological hypotheses for the significant increase in myopia in industrialized countries is based on the excessive use of computer display screens [20].

## 5. Conclusion

Refractive errors therefore constitute a reality and a major public health problem among school children who represent our future and the builders of tomorrow. The risk of amblyopia represents a great danger for the future of these children and therefore requires rapid treatment and good planning by the authorities for screening all children.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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