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Research Article

Prevalence and Associated Factors of Ametropia among Schoolchildren Aged at Least 6 Years in North Benin

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Abstract

Introduction: Ametropias are the first reason for ophthalmological consultations of school children. It is a public health problem and one of the main causes of visual impairment in the world.

Purpose: To study the prevalence and associated factors of ametropias among primary school children aged 6 years old and over in the commune of Parakou in 2020.

Patients and Methods: This was a cross-sectional, descriptive and analytical study that took place from july 1st to 30 th september 2020. It involved school children aged at least of 6 years old, residing in the commune of Parakou and enrolled in the various elementary school in this commune for the 2019 - 2020 school year.

Results: A total of 810 children aged 6 - 15 years old had participated to the study. The prevalence of ametropias was 19.87%. The 6 - 7-years-old age group had the most ametropia (34.40%). A female predominance had been objectified (52.23%). Hyperopia was the most represented refractive abnormally (42.68%), followed by astigmatism (39.49%) and myopia (22.93%). Ocular pruritus ($p = 0.000$) and studying with poor luminosity ($p = 0.001$) were statistically significantly associated with ametropia. Age ($p = 0.0164$), sex ($p = 0.0095$), father's socioeconomic status index ($p = 0.0002$), mother's socioeconomic status index ($p = 0.013$), and parental history of wearing corrective lenses ($p = 0.0178$) were statistically significantly associated with hyperopia. On the other hand, history of prematurity ($p = 0.0428$) and malnutrition ($p = 0.000$) were statistically significantly associated with astigmatism and only malnutrition ($p = 0.0001$) was statistically associated with myopia. However, 3.82% of ametropes were amblyopic.

Conclusion: Ametropia still be a major concern in the children school setting because of its significant prevalence (19.87%) and its complications, which are preventable with early diagnosis and management.

Keywords: Ametropia; Prevalence; Associated Factors; Schoolchildren; Parakou

Introduction

An eye with normal refraction is said to be emmetropic. It sees the image of the observed object, in near or far vision, forming on the retina. When the image does not form on the retina, vision is blurred. There is then an ametropia or refractive error [1]. Ametropia is the primary reason for ophthalmologic consultation in school children [2] and could be responsible for visual impairment and

many school failures among children. In fact, 80% of informations related to learning passe through the sight. If vision problems are detected early enough, it will be easier to correct them and they will be less likely to disrupt children's education. The difficulty is that few children report their visual impairment to those around them. The observation is often made by parents and it is often too late.

Aim of the Study

The aim of this work was to study the prevalence and associated factors of ametropia among school children aged at least 6 years old in Parakou commune of Parakou in 2020.

Setting, Patients and Methods

This was a descriptive and analytical cross-sectional study with prospective data collection which took place over a period of 3 months from July 1st to September 30th, 2020. It took place in the commune of Parakou, more precisely in 24 arrondissements and neighborhoods of the municipality of Parakou initially, then in the ophthalmology service of the Departmental University Hospital of Borgou/Alibori (CHUD-B/A) in a second time.

Were included in the study, school children aged at least 6 years old, residing in the commune of Parakou and enrolled in the various primary schools of this commune for the 2019 - 2020 school year.

The variables studied were made up of socio-demographic characteristics, anamnestic elements (history, functional signs, etc.), the results of the complete ophthalmological examination (measurement of visual acuity, results of the skiascopy performed after cycloplegia), the results of general examination (measurement of anthropometric parameters, etc.), the diagnosis selected (the type of ametropia, associated pathologies) and the treatment administered. To determine ametropia, measurement of near and far visual acuity (in monocular) was carried out in the population, respecting the measurement conditions and using suitable optotypes. Thus, children whose far visual acuity measurement was ≤ 7/10 in at least one eye and/or near visual acuity measurement was > at Parinaud 2 (P2) with the normal full ophthalmologic examination were found to be ametropic. The latter then underwent a skiascopy after cycloplegia with cyclopentolate eye drop 0,5%, the results of which enabled us to distinguish the type of ametropia. Thus, myopia was low if <-3D, medium if between -3 and -6D and high if > -6D [3]. Hyperopia was mild if <+2 D, moderate if between +2 and +5 D, high if > +5 D [4]. Astigmatism was mild if it was between 0 and 2 D, medium if it was between 2 and 4 D, and high if it was greater than 4 D [5]. Anisometropia has been defined as a refractive difference of at least 1.5 D between the two eyes [6].

The data collected were recorded and processed respectively with the software Epi-data 3.1 and Epi info 7.2.2.2. After data entry, data consistency and any data entry errors were checked. Microsoft Word 2016 software was used for entering the thesis and Excel 2016 for organizing the data in the form of tables and graphs. Qualitative variables were expressed as a percentage with their confidence interval and quantitative variables averaged with their standard deviation. The significance level was 5%. Crosses were made using various statistical tests such as Chi square.

Results

Sociodemographic characteristics

Even though all of the 810 children in our study received a visual acuity test at the start, it should be noted that the final participation rate was 97.53%. Because 20 children with reduced visual acuity could not be present for the performance of the complete ophthalmologic examination for various reasons.

Age

The mean age of the study subjects was 9.27 ± 2.21 years old with extremes of 6 years and 15 years. The 10 - 11 years old age group was the most represented with 28.40%.

Sex

Male children made up 51.98% of the participants. The sex ratio was 1.08.

Level of study

The middle class second year (MC2) was the most represented with 22.84%.

Ethnic group

The Fon and relatives and the Bariba were the most represented ethnic groups with 26.30% and 25.06% respectively.

Class repetition

In our series, 30.49% of the children questioned declared having already repeated a class at least once.

Parents socioeconomic position index [7] (PSEI)

In our series, fathers had an average-lower level in 51.85% of cases and mothers in 49.88%.

Background

Personal history of wearing corrective lenses

In our series, three children, or 0.37%, already wore corrective lenses. The power of corrective lenses was unknown.

Family history of wearing corrective lenses

In total, 125 children or 15.43% had at least one member of the family who wore corrective lenses and this was mostly the father (56.00%).

Other antecedents

Sixty-three children or 7.78% were born prematures.

Clinical features

Complaints

In our series, the main complaints reported by children were: pruritus (36.30%), photophobia (25.06%) and headache (20%).

Visual acuity

In our series, 17.53% (n = 142) of the children had a far visual acuity ≤ 7/10 in the right eye and 18.89% (n = 153) of the children had a far visual acuity ≤ 7/10 to the left eye. Most of the children, 93.82% (n = 760) had good near visual acuity without correction and 6.18% had poor near visual acuity without correction> P2. The decline in visual acuity (whether near or far) was detected in 178 children, a percentage of 21.98%.

Retained diagnosis

Slit lamp examination was performed in 158 children. 16 (10.19%) had ametropia with associated pathologies. Table 1 indicates the different diagnoses retained after complete ophthalmological examination.

	Workforce	Percentage
Ametropia RE/LE	141	89.80
Ametropia + allergic conjunctivitis RE/LE	9	5.70
Ametropia + LCET stage 2 RE/LE	3	1.90
Ametropia + LCET stage 3 RE/LE	2	1.27
Ametropia + LCET stage 1 RE/LE	1	0.63
Ametropia + retinitis pigmentosa RE/LE	1	0.63
Right eye trauma with blindness	1	0.63
Total	158	100.00

Table 1: Distribution of children according to the diagnosis retained after complete ophthalmological examination (Municipality of Parakou, July - September 2020) (n = 158).

Prevalence of ametropia

After the complete ophthalmologic examination, 157 children were ametropic, for a prevalence of 19.87% 95% CI [17.24 - 22.80].

Types of ametropia

Hyperopia was the most common refractive error with 42.68%. It was followed by astigmatism (39.49%) and myopia (22.93%).

The age group 6 - 7 years old was the most experienced with ametropic disease, as shown in table 2.

A clear predominance of female was noted for hyperopia with 62.69%. The distribution of children according to their sex and according to the different types of ametropia is presented in table 3.

	Age				
	6-7 years	8-9 years	10-11 years	12-13 years	14-15 years
Astigmatism	17 (31.48%)	19 (40.43%)	17 (44.74%)	6 (42.86%)	3 (75.00%)
Myopia	13 (24.07%)	9 (19.15%)	8 (21.05%)	6 (42.86%)	0 (00.00%)
Hyperopia	25 (46.30%)	23 (48.94%)	16 (42.11%)	2 (14.29%)	1 (25.00%)

Table 2: Distribution of children according to the types of ametropia according to age (Municipality of Parakou, July - September 2020).

	Male	Female
Hyperopia	25 (37.31%)	42 (62.69%)
Astigmatism	33 (53.22%)	29 (46.77%)
Myopia	21 (58.33%)	15 (41.67%)

Table 3: Distribution of children according to the types of ametropia according to sex (Municipality of Parakou, July - September 2020).

Treatment

All ametropic patients underwent optical correction and the associated pathologies were treated. After correction, 98.09% of the children had good for visual acuity (8/10 to 11/10) but, 1.91% had a far visual acuity between 5/10 and 7/10.

Amblyopia and anisometropia

Functional amblyopia was found in 6 children, i.e. a prevalence of 3.82%. A weak anisohypermetropia was found (0.64%).

Associated factors

Factors associated with univariate analysis

Father's and mother's age, IPSE, ocular itching, and not studying in good light were significantly associated with ametropia with a p-value of less than 0.05. Malnutrition was statistically significantly associated with myopia (p = 0.000) and astigmatism (p = 0.000). The history of prematurity (p = 0.0428) was with astigmatism in the series. It appeared that the age (p = 0.0164), the sex (p = 0.0095), the IPSE of the father (p = 0.0002), that of the mother (p = 0.013) and the antecedent of corrective lens wear by parents (p = 0.0178) were statistically significantly associated with hyperopia.

Factors associated with multivariate analysis

Children whose parents said they had itchy eyes and did not study in good light were at risk of developing ametropia. Malnourished children were 16.81 times more likely to have myopia (p = 0.000) and 7.36 times more likely to have astigmatism (p = 0.0001). Children whose parents said they did not sleep in very good light for two years (p = 0.0272; PR = 2.0175) and females (p = 0.00238, PR = 2.086) presented a risk of hyperopia.

Discussion

This study was carried out with an accuracy of 3%, which made it possible to reduce the margin of error and to have a well representative sample. Our results can therefore be extrapolated to all school children in the municipality of Parakou. However, it could not be done in schools like most studies done on school children, due to the coronavirus (covid-19) pandemic, which had resulted in a suspension of classes during the study period. The relationship between heredity and ametropia could not really be made, as the nature of corrective, non-presbyopic lenses was difficult for students and their parents to understand. The educational impact of ametropia has not been studied. A longitudinal study could have been carried out to do this.

All children with reduced visual acuity could not be examined. The final participation rate, however significant, of 97.53% reflects the good level of support for this study. This rate is a little higher than those reported by Nonon Saa., *et al.* [8] in Togo in 2013, Assoumou., *et al.* [9] in Gabon in 2015 and Sounouvou., *et al.* [10] in Benin in 2008, which were 68%, 82.8% and 88.6% respectively.

The mean age of the study subjects was 9.27 years ± 2.21. It is similar to that reported by Rakotoarisoa., *et al.* [11] in Madagascar and Nonon Saa., *et al.* [8] in Togo who were 9.02 years old and 10.07 ± 2.3 years old, respectively. It is comparable to that reported by other authors, including Ayed., *et al.* [12] in 2000 in Tunisia who had carried out a study as part of a screening in four cities, Odoulami-Yehouessi., *et al.* [13] in 2005 in Benin and Eddrazi., *et al.* [2] in 2013 in Morocco which were based on hospital data. These mean ages were 11.9 ± 3.21 years, 12.50 ± 2.14 years and 8.8 ± 2.2 years, respectively. The 6 - 7 year old age group had the most ametropic drugs at 34.40%. The frequency of ametropia gradually decreased with increasing age. This result could be explained by the existence of an intense emmetropization phenomenon at this age and which gradually decreases with increasing age, ending between 12 and 13 years [14].

Male children represented 51.98% of the children in the study. This result could be explained by the fact that in our regions, boys are primarily educated. However, a female predominance of refractive errors was observed (52.23% against 47.80% of boys). This has also been observed by Mahjoob., *et al.* [15] in Iran (73.1%), Hashim., *et al.* [16] in Malaysia (69.40%), Kouassi., *et al.* [17] in Ivory Coast (75.55%) and Sounouvou., *et al.* [10] (51.8%) in Benin. However, Odoulami-Yehouessi., *et al.* [13], Rakotoarisoa., *et al.* [11] had conflicting results with male predominance.

In this study, there was no statistically significant difference between level of study and ametropia. On the other hand, Assou-

mou., *et al.* [9] noted this in their study. This lack of association in our study could be explained by the delay in the schooling of the children in our series and by the fairly significant repetitions (30.49%). The difference in grade repetition was not statistically significant. But, Ayed., *et al.* [12] noted that ametropia of all types was highly associated with school failure. This could be explained by the fact that in our context, school failures would not only be due to ametropia but also to other factors inherent in the education system and in students (teachers' strikes, failure of educators, lack of motivation or lack of interest on the part of the pupil, intellectual deficit, learning problems such as dyslexia, dyscalculia, the family and socio-cultural context).

Only 0.37% of children already wore corrective lenses. Our proportion of previous use of corrective lenses by ametropia contrasts with that found among the other authors. Eddrazi., *et al.* [2] in Morocco and Ayed., *et al.* [12] in Tunisia, reported 15% and 18.7% respectively. Still others had reported higher proportions. These are Maul., *et al.* [18] in Chile and Goh., *et al.* [19] in Malaysia which found 25.3%, 49.4% respectively. However, our result approached that of Kawuma., *et al.* [20] in Uganda where, out of 623 children examined, none wore corrective lenses. This considerable difference in results could be explained by the low socioeconomic level of our populations [21]. El-Bayoumy., *et al.* [22] had shown this in their study where they reported that more than half of ametropic patients came from families where the socioeconomic level was low. It should be noted that the high cost of corrective glasses pushes parents to resort to other stratagems after the discovery of their child's refractive errors (self-medication, change of place in the classroom, etc.). Neglect of symptoms, ignorance of parents, lack of information's and awareness also contribute. The young age of the children does not allow them to clearly express their complaints and thus reduces their credibility.

The prevalence of ametropia among schoolchildren aged 6 and over in Parakou commune in 2020 was 19.87%. This result corroborates that of Kouassi., *et al.* [17] in Côte d'Ivoire, which found a prevalence of 21.40%. However, it was higher than those reported by the Beninese authors, Sounouvou., *et al.* [10] (10.6%), Odoulami-Yehouessi., *et al.* [13] (9.2%) and Assavèdo., *et al.* [23] (11.5%). The same was true for Nonon Saa., *et al.* [8] in Togo (3%) and Al-Rowaily., *et al.* [24] in Saudi Arabia (4.5%). On the other hand, Farid., *et al.* [25] found a higher prevalence than ours with 68%. Eballe., *et al.* [26] in Cameroon found a prevalence of 43.1%, Abdul-Kabir., *et al.* [27] in Ghana 30.29%, Maul., *et al.* [18] chili 56.3%. This difference between our results and those of other studies could be related to ethnic, genetic, environmental factors on the one hand and dissimilarities in the setting and methods of study on the other hand.

Hyperopia was the most common refractive error (42.68%), followed by astigmatism (39.49%) and myopia (22.93%). Unlike the results of other studies [2,8,10,11,23], where astigmatism was the most common ametropia. Our proportions are similar to those of Eballe., *et al.* [26], where hyperopia (54.94%) was the leading cause, followed by astigmatism of all types (30.22%) and finally myopia (14.84%). The same was true for Kouassi., *et al.* [17] in Ivory Coast, Ayed., *et al.* [12] in Tunisia and Mahjoob., *et al.* [15] in Iran. For others [13,27,28], myopia was the most common.

In our study, as in other authors studies [2,10,13] we found that mild ametropia was largely dominant.

Hyperopia (42.68%) was found more in children 6-11 years old (95.52%), and gradually decreased with increasing of age. This data is similar to that of other authors. Thus Eddrazi., *et al.* [2], who had carried out a study on the epidemiology of refractive disorders in children, found it to be common in children 9 to 11 years old, with an overall prevalence of 35%. For Kouassi., *et al.* [17], who had evaluated the refraction in a school environment, it was 67.32%. Ahmed., *et al.* [29] studied the epidemiological profile of hyperopia in primary schools in Tunisia on 6192 children and found an overall prevalence of 2.61%. All of these authors agreed on a significant decrease of the prevalence of hyperopia with age. This variability could be related to a decrease in the dioptric power of the lens (it goes from 23 diopters at the age of 3 years, to 20 diopters at the age of 14 years), or with an increase in optical density of the crystalline cortex [30]. Female children (PR = 2.0861) had a higher risk of developing hyperopia. Other authors have followed suit. Farid., *et al.* [25] found a statistically high proportion of hyperopia in girls (108/144). Maul., *et al.* [18], Hashim., *et al.* [30] showed, like us, a significantly higher risk of hyperopia in girls than in boys. Other authors [12,29] have found a predominance of female without a statistically significant relationship. But for Eddrazi., *et al.* [2], hyperopia was found more in boys. Parents' history of wearing corrective lenses (p = 0.0178) was also statistically significantly associated with hyperopia. This could be explained by the fact that, the hyperopic becomes presbyopic more quickly and therefore will be more inclined to quickly correct his visual deficit. This result confirms that of Speeg-Schatz., *et al.* [6] who discussed

the hereditary etiology of ametropia. Other studies have been able to study the school impact of hyperopia. Ahmed., *et al.* [29] in 2010, noted an academic delay of at least one year in more than 75% of farsighted people.

Astigmatism accounted for 39.49% of ametropia in our study. Higher prevalences have been reported by Sounouvou., *et al.* [10] (91.9%), Assavèdo., *et al.* [23] (70.7%), Odoulami-Yehouessi., *et al.* [13] (62.38%) in studies carried out in southern Benin. This difference could therefore be linked to environmental, ethnic, genetic and methodological factors. Assoumou., *et al.* [9] (89.2%) and Eddrazi., *et al.* [2] (46.7%) also had better results than ours. On the other hand, lower prevalences had been reported by Kouassi., *et al.* [17] (16.53%) and Mahjoob., *et al.* [15] (3.4%). It was more common in the 8 - 9 years old age group and was found mostly in boys (53.23%). Sounouvou., *et al.* [10] had reported the same age group but with a predominance of female. For Eddrazi., *et al.* [2], there was a male predominance but the 9 - 14 years old age group was more affected. Assoumou., *et al.* [9] found a difference between the age groups statistically significant and that of 7 - 8 years old had more astigmatism. History of prematurity (p = 0.0428) and malnutrition (p = 0.000) were statistically significantly associated with astigmatism in the series. This could be explained by the immaturity of almost all the organs of the premature baby. Bradley., *et al.* [31] had carried out a study on the progression of astigmatism in the early treatment of retinopathy of prematurity up to the age of 6 years. For these authors retinopathy of prematurity (ROP) is at the origin of the strong astigmatism observed in more than a quarter of these children at school age. Malnourished children were 7.36 times more likely to have astigmatism (p = 0.0001). Acute malnutrition was the one we found in our study. It causes eye disorders and therefore could be responsible for indicative ametropia. Regarding the relationship between astigmatism and academic performance, some authors, notably Assoumou., *et al.* [9] reported that astigmatism of all types was statistically associated with grade repetition significantly in 23% of cases. The same observation was made by Ayed., *et al.* [12] who reported a rate of 38.8% of academic delay of more than 2 years.

The prevalence of myopia in our study was 22.93%. The age group of 6 - 7 years old was the most affected and it gradually decreased with increasing age. Eddrazi., *et al.* [2], found a prevalence of 18.3%. Children aged 9 - 11 years old were more affected and then it gradually diminished with age. For Sounouvou., *et al.* [10], no case of myopia has been observed beyond the age of 13 years. Studies by Al-Rowaily., *et al.* [24], Farid., *et al.* [25], Odoulami-Yehouessi., *et al.* [13], had higher frequencies, respectively 75%, 55.3% and 32.26%. On the other hand, studies carried out in Madagascar [11], Tunisia [12] and Gabon [9] had reported lower frequencies. Other studies have noted an increase in the prevalence of myopia with age, as reported by Ayed., *et al.* [12] and Goh., *et al.* [19]. Assoumou., *et al.* [9] found an almost equal distribution of nearsightedness in the 5 - 6 years, 7 - 8 years and 9 - 10 years old age groups, without significant variation. Unlike Ayed., *et al.* [12], who found a significant increase in myopia with age. All of these disparities could be related to genetic and environmental factors. The male sex was the most affected (58.33%). This result is superimposable on that of Eddrazi., *et al.* [2] and Rakotoarisoa., *et al* [11]. On the other hand, Assoumou., *et al.* [9] and Ayed., *et al.* [12], found a female predominance. Odoulami-Yehouessi., *et al.* [13] as for them, had not found a predominance but equality between the sexes. In view of all the above, we can say that myopia is not linked to sex. In our series, malnutrition was significantly associated with myopia and malnourished children were 16.81 times more likely to have myopia. This association is explained by the fact that malnutrition promotes myopia [6]. Indeed, protein-calorie malnutrition is due to a nutrient deficit. Edwards., *et al.* [32] compared the nutritional intake of a group of children who subsequently became myopic with that of a group who did not become myopic. As a result, children who developed nearsightedness generally had lower intake of many of the food components than those who did not. Others have shown that sun exposure in combination with riboflavin was able to strengthen the structure of the sclera of the eye so that it is less prone to the stretch associated with axial lengthening in myopia. Although these studies do not demonstrate that the sclera is strong enough to resist this stretching common in progressive myopia [33]. The relationship between myopia and its impact on school could not be studied in this study. However, Ayed., *et al.* [12] found that myopia was statistically highly significantly associated with academic delay.

Several pathologies were associated with ametropia in our series. Allergic conjunctivitis was the leading one with 56.25%, followed by LCET with 37.5% and retinitis pigmentosa with 6.25%. Assavèdo., *et al.* [34] in 2010, had studied the epidemiological and clinical aspects of eye diseases in children aged 0 to 15 years in the ophthalmology department of CHUD-B/A in Parakou. In this study, conjunctival pathologies represented 58.4% and the main aetiology was conjunctivitis. For Eballe., *et al.* [18], conjunctival disorders

(33%) were dominated by LCET (17.8%). This could be explained by the fact that LCET and conjunctivitis are very common pathologies in children in tropical regions.

Conclusion

The prevalence of ametropia among school children aged at least 6 years old in the commune of Parakou in 2020 was 19.87%, therefore significant. Hyperopia was the most common refractive error, followed by astigmatism and myopia. Several factors were associated with ametropia. Eye itching and studying in poor light were statistically associated with ametropia. Father's age, sex, socioeconomic position index, mother's, and parental history of wearing corrective lenses were statistically significantly associated with hyperopia. In opposite, a history of prematurity and malnutrition were statistically significantly associated with astigmatism and only malnutrition was so with myopia. We were unable to establish a link between ametropia and academic performance. However, 3.82% of ametropic patients were amblyopic. This major complication of ametropia could have been avoided if early detection had been carried out. Ametropia remains a major concern in schools given their significant frequency and the resulting complications. These can be avoided with early diagnosis and management.

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