Original Article

Prevalence and pattern of refractive errors in high schools of Nyarugenge district

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ABSTRACT

Background: Refractive errors are common in many developing countries; causing significant loss of vision in case of high refractive errors with no appropriate correction. Data on refractive errors in Rwanda is not available. This study will enable us to get accurate data for proper action.
Objectives: To determine the prevalence, characteristics and complications related to refractive errors in high schools of Nyarugenge district.
Methods: A cross-sectional study carried out on 634 high school students, aged 11 to 37 years, from Nyarugenge district, between April to May 2013. They completed eye examinations including cycloplegic refraction. Automatic refraction was measured using a Retinomax1.
Results: Examined students were aged between 11 and 37 years, with a mean of 17.02±2.68 (SD) years. Most affected students were aged between 11 and 20 years (88.3%). There were 56.6% of female and 43.4% of male, with a ratio of 1.3; however there was no statistical difference. The prevalence of refractive errors was 18.9%. There was no relation between refractive errors and the age, gender and level of education of students. (RR respectively 0.34, 0.51 and 0.36). From a total number of 120 students with refractive errors, only 32 (26.7%) were wearing spectacles. The main reason of not wearing spectacles was lack of awareness for 90 students (75%), followed by high cost for 25 students (21%). Prevalence of myopia, hypermetropia, astigmatism and anisometropia was respectively 10.2%, 4.3%, 4.4% and 1.9%. 7 (2.8%) students developed high myopia. Observed complications due to refractive errors were amblyopia and strabismus with respectively 9(1.4%) and 4(0.6%) students. We found no statistical difference between developing myopia, hypermetropia, astigmatism and anisometropia in all different age groups, gender and education level.
Conclusion: Prevalence of refractive errors in high schools of Nyarugenge district was high; myopia was the most important.. No association was found between developing refractive errors and respectively the age, gender and education level. Main complications due to lack of appropriate correction of refractive errors were amblyopia and strabismus. Only one third of students with refractive errors were wearing glasses. The main reasons of not wearing spectacles were lack of awareness and high cost of spectacles.

Keywords: Prevalence, pattern, refractive errors, Nyarugenge district

RESUME

Introduction: les erreurs de réfraction sont communes dans beaucoup de pays en voie de développement, causant des troubles majeurs de la vision lorsqu'un traitement approprié n'est pas réalisé. Au Rwanda, il n'existe pas de statistiques à propos d'erreurs de réfraction. Cette étude permettra d'obtenir des données précises à ce sujet.
Objectifs: déterminer la prévalence, les caractéristiques ainsi que les complications associées aux erreurs de réfraction chez les étudiants des écoles secondaires du district de Nyarugenge.
Méthodes: Une étude transversale a été réalisée sur 634 étudiants âgés de 11 à 37 ans, provenant du district de Nyarugenge entre le mois d'avril et mai 2013. Un examen ophtalmologique incluant la réfraction cycloplégique était réalisé. La réfraction automatique était obtenue à l'aide de retinomax1.
Résultats: Les étudiants examinés étaient âgés de 11 à 37 ans, avec une moyenne de 17,02 ± 2, 68 (DS) ans. La majorité d'étudiants affectés étaient âgés de 11 à 20 ans (88,3%). Il a été observé 56,6% de filles et 43.4% de garçons, avec un ratio de 1.3; cependant il n'y avait pas de différence statistique. La prévalence d'erreurs de réfraction était de 18,9%. Aucune relation n'a été trouvée entre l'erreur de réfraction et respectivement l'âge, le genre ainsi que le niveau d'éducation.(RR 0,34 ; 0,51 et 0,36). Sur un total de 120 étudiants avec erreurs de réfraction, 32(26,7%) portaient des lunettes. La principale raison du manque de port des lunettes était l'ignorance: 90(75%) étudiants. Une autre raison d'absence du port des lunettes était le prix élevé des lunettes: 25 étudiants (21%). La prévalence de la myopie, l'hypermétropie, l'astigmatisme ainsi que l'anisométropie étaient respectivement de 10,2%, 4,3%, 4,4% et 1,9%. La myopie sévère représentait 7(2,8%) d'étudiants. Les complications liées aux erreurs de réfraction étaient l'amblyopie et le strabisme, respectivement 9(1,4%) et 4(0,6%) d'étudiants. Il a été observé aucune différence statistique entre les différents types d'erreurs de réfraction et les groupes d'âge, de genre et le niveau d'éducation.
Conclusion: La prévalence d'erreurs de réfraction des étudiants des écoles secondaires du district de Nyarugenge était élevée. La myopie représentait la plus importante erreur de réfraction. Aucune association n'a été trouvée entre l'erreur de réfraction et respectivement l'âge, le genre et le niveau d'éducation. Les complications liées à l'absence d'un traitement approprié aux erreurs de réfraction étaient amblyopie et strabisme. Seulement un tiers des étudiants avec erreurs de réfraction portaient des lunettes. La raison principale du manque de port des lunettes était l'ignorance et le prix élevé des lunettes.

Mots Clés : Prévalence - Charactéristique - Erreurs de réfraction - District de Nyarugenge

INTRODUCTION

While refractive errors are common among populations in many developing countries, they have not been regarded as a significant problem that could benefit from public health measures. Indeed, more attention is frequently given to some less common health problems in the same countries. This attitude is due to the assumption that refractive errors are a benign, not life-threatening minor nuisance, and that they do not merit measures that may appear out of proportion to their low priority [1]. However, in some countries, there seems to be a high demand by patients and healthcare workers for more consideration

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to be given to refractive errors [1]. For students, the inability to read standard-sized print, to see the chalkboard, overhead projection, or the computer, or to discriminate color can have a significant impact on their educational development [2, 3]. Parents and educators need information regarding the student's visual abilities, as well as how to maximize the use of remaining vision, and strategies to modify the environment or task to minimize the disabling effect of the visual impairment on performance. Loss of independence and the ability to enjoy leisure activities are predominant concerns of the older adult with a visual impairment [4]. Recent data suggest that a large number of people are blind in different parts of the world due to high refractive error because they are not using appropriate refractive correction [5,6,7,8]. Blindness due to refractive error in any population suggests that eye care services in general are inadequate. Strategies such as vision screening programs need to be implemented on a large scale to detect individuals suffering from refractive error blindness. Sufficient numbers of personnel and adequate infrastructure need to be put in place so that affordable quality spectacles are available to needed people. All these will require a comprehensive approach in the treatment of high refractive errors [3].

Uncorrected refractive errors can affect performance at school, reduce employability and productivity, and generally impair quality of life [7]. Yet the correction of refractive errors with appropriate spectacles is among the most cost-effective interventions in eye health care [9]. In 2006, a survey done on adult people in Western Rwanda found 60.7% of severe visual impairment while refractive error was responsible of almost one-third of cases with visual impairment [10]. All these information stimulated us in performing this study so that data from our setting can be obtained for proper planning in the future.

Main objective:

To assess the prevalence and pattern of refractive errors among high school students of Nyarugenge district.

Specific objectives:

-To determine the prevalence of students having refractive errors in high schools of Nyarugenge district.

-To determine the characteristics and types of refractive errors in high schools of Nyarugenge district.

-To determine the complications related to refractive errors in high schools of Nyarugenge district.

METHODS

This study was conducted in high schools of Nyarugenge district; Nyarugenge district with 284.860 peoples, living in an area of 134 square kilometres. This district has 31 schools, with a total of 14.753 students from all provinces of Rwanda, both rural and urban areas. This was a cross-sectional study carried out on students from high schools of Nyarugenge district. We used the classic formula for sample size calculation

(Equation): $\frac{n=d(z^2 \times p \times q)}{\alpha^2}$

Where, n: minimum sample size, d: cluster effect= 2 because the size of the cluster was < 50, z: confidence interval at 95%= 1,96, p: current prevalence of the problem was equal to 0,25, q: 1- p= 1- 0,50= 0,75, α: precision=5% [1].

$$n= \frac{2 \times (1,96 \times 1,96 \times 0,25 \times 0,75)}{0,05 \times 0,05}= 576 \text{ students}$$

Add 10% for potential refusal= 58 students, therefore, we selected and examined a total of 634 students.

Selection of students

A list of all high schools in Nyarugenge district (sampling frame) was provided by the Ministry of Education. High schools were considered as the survey clusters. According to the Ministry of Education, Nyarugenge district has 31 schools with a total of 14.753 students, which translate to an average of 476 students per school. For economic reasons, time available and after statistical estimation, a sample of 13 schools (42% of the total high schools of the District) was selected using the simple random sampling method. These were: Lycée de Kigali, Lycée Notre dame de Citeau, College Saint André, GS Akumunigo, ESSI Nyamirambo, GS EPA Saint Michel, GS Kabusunzu, College APACOPE, GS AP Rugunga, ETM1, Ecole Technique Saint Joseph, GS Mont Kigali APACE and GS Cyahafi. The sample was distributed proportionally to the population size (total number of students) of a school as follows: the sampling interval was the total number (14,753) of students divided by the sample size 634 = 23. The total number of students in a specified school was then divided by 23 to calculate the number of students to be studied in that school. For example a in a school with a total of 2,300 students, 100 students (2300/23) were examined while in a school with 4,600 students, 200 (4,600/23) were examined. In each school, we used the school registers as the sampling frame from which we selected individual students, using systematic sampling method. A random starting point was selected and every 23rd student examined. For example if the random starting point was student number 11 on the register, then the students selected was 11th, 34th (11+23), 57th, 80th, 103rd…until the sample allocated for the school was achieved. All high school students who voluntarily accepted to participate in this study were included. Students under the age of giving consent were to call their parents for consent form signature. Were excluded from this study, high school students diagnosed with other blinding conditions.

Procedure

This is a cross-sectional study performed by an ophthalmologist on high school students of Nyarugenge district. Clinical history about present and past ocular problems, medical or surgical treatment, and family history were obtained. Visual acuity was tested with and/or without correction, using a projector. For those with best corrected visual acuity worse than 6/12, a complete ophthalmic examination was performed. For dilated students, a consent form indicating the drug and dosage used was taken. Automatic refraction was performed using retinomax1, on both eyes of selected students with an average of 5 readings for each eye. 3 sessions on the collection of data using retinomax1 was performed before the field work. Myopia was defined as spherical error of at least -0.50 diopters. High myopia was defined as spherical error of at least -6.00D. Hyperopia was defined as spherical error of at least +0.50D. Astigmatism was defined as cylinder of at least 0.50D. For patients with

strabismus, ocular motility was evaluated with a cover test at 0.5 meters. Spectacle prescriptions were provided to the students with refractive errors. All data obtained were put in questionnaire and analyzed by SPSS version 16.0 and epi info 3.5.1. $\chi 2$ test was used to compare proportions in categories and Fisher test was used to calculate p values for comparison of prevalences for individual categories. Correlation and linear regression models were constructed to assess associations, while adjusting for age. P value was reported as statistically significant as less than 0,05. Before starting our research, we got permission from the SPH/ NUR/ KUTH Ethical and Research Committee, Nyarugenge district Mayor's as well as the Head master of each selected high school. The name of participants will not be disclosed to ensure the confidentiality. The secrecy governing the medical ethics was respected with all records kept anonymously at all stages of the survey. Before the survey, students were asked to give voluntarily their written informed consent before participating to the study. All participants found with refractive errors were given prescription of glasses.

RESULTS

From a total of 14753 students from 31 high schools of Nyarugenge district, refractive error examinations were performed on 634 students selected randomly from 13 high schools.

Table 1: Distribution of students by gender, age and education level

Examined students			Students with refractive errors		p value
Gender	**N (%)**	**95% CI**	**N (%)**	**95% CI**	**0.34**
Male	275 (43.4)	[39.9, 47.4]	46 (7.2)	[5.2, 9.3]	
Female	359 (56.6)	[52.7, 60.5]	74 (11.7)	[9.2, 14.3]	
Total	634 (100)		120 (18.9)	[15.9, 22.2]	
Age groups	**N (%)**	**95% CI**	**N (%)**	**95% CI**	**0.51**
<13	12 (1.9)	[1.6, 2.2]	0 (0)	[0, 0]	
13- 16	260 (41)	[37.2, 44.9]	51 (8)	[5.9, 10.2]	
17- 20	300 (47.3)	[43.4, 51.3]	56 (8.8)	[6.6, 11.1]	
21- 24	58 (9.1)	[6.9, 11.4]	8 (1.3)	[0.4, 2.2]	
>24	4 (0.6)	[0.41, 7.9]	5 (0.8)	[0.1, 1.5]	
Total	634 (100)		120 (18.9)	[15.9, 22.2]	
Education level	**N (%)**	**95% CI**	**N (%)**	**95% CI**	**0.36**
Year 1	130 (20.5)	[16.9, 23.2]	25 (3.9)	[2.4, 5.4]	
Year 2	114 (18)	[15.0, 21.1]	18 (2.8)	[1.5, 4.1]	
Year 3	90 (14.2)	[11.5, 17.0]	15 (2.4)	[1.2, 3.6]	
Year 4	89 (14)	[11.5, 17.0]	17 (2.7)	[1.4, 4.0]	
Year 5	114 (18)	[15.0, 21.1]	27 (4.3)	[2.7, 5.9]	
Year 6	97 (15.3)	[12.5, 18.2]	18 (2.8)	[1.5, 4.1]	
Total	**634 (100)**		**120 (18.9)**	**[15.9, 22.2]**	

Examined students were aged between 11 and 37 years, with a mean of 17.02± 2.68 (SD) years. Majority of these students (88.3%) were aged between 13 and 20 years. There were 56.6% of female and 43.4% of male, with a ratio of 1.3; however there was no statistical difference between boys and girls (p=0.49). The prevalence of refractive errors was 18.9%. There was no relation between refractive errors and the age, gender and level of education of students (RR respectively 0.34, 0.51 and 0.36). From a total number of 120 students with refractive errors, 32 (26.7%) were wearing spectacles. The main reason of not wearing spectacles was lack of awareness for 90 students (75%), followed by high cost for 25 students (21%).

Table 2: Distribution of myopia by gender, age, education level and visual complication

	Myopia	High myopia	Prevalence of myopia		p value
Gender	**N (%)**	**N (%)**	**N (%)**	**95% CI**	**0.57**
Male	21 (3.3)	4 (0.6)	25 (3.9)	[2.4, 5.4]	
Female	37 (5.8)	3 (0.5)	40 (6.3)	[4.4, 8.2]	
Total	58 (9.1)	7 (1.1)	65 (10.2)	[7.8, 12.6]	
Age groups	**N (%)**	**N (%)**	**N (%)**	**95% CI**	**0.39**
<13	0 (0)	0 (0)	0 (0)	[0, 0]	
13- 16	27 (4.2)	4 (0.6)	31 (4.9)	[3.2, 6.6]	
17- 20	26 (4.1)	3 (0.5)	29 (4.6)	[3.0, 6.3]	
21- 24	5 (0.8)	0 (0)	5 (0.7)	[0.1, 1.4]	
>24	0 (0)	0 (0)	0 (0)	[0, 0]	
Total	58 (9.1)	7 (1.1)	65 (10.2)	[7.8, 22.2]	
Education level	**N (%)**	**N (%)**	**N (%)**	**95% CI**	**0.93**
Year 1	11 (1.5)	1 (0.1)	12 (1.9)	[0.8, 3]	
Year 2	8 (1.3)	2 (0.2)	10 (1.6)	[0.6, 2.6]	
Year 3	8 (1.3)	2 (0.2)	10 (1.6)	[0.6,2.6]	
Year 4	8 (1.3)	1 (0.1)	9 (1.4)	[0.5, 2.3]	
Year 5	13 (2)	1 (0.1)	14 (2.2)	[1.1, 34]	
Year 6	10 (1.6)	0 (0)	10 (1.6)	[0.6, 2.6]	
Total	58 (9.1)	7 (1.1)	65 (10.2)	[7.8, 22.2]	
Visual complications	**N (%)**	**N (%)**	**N (%)**	**95% CI**	**0.32**
Amblyopia	0 (0)	6 (0.9)	6 (0.9)	[0.2, 1.7]	
Strabismus	0 (0)	1 (0.2)	1 (0.2)	[-0.1, 0.6]	
Total	0 (0)	7 (1.1)	7 (1.1)	[0.3, 1.9]	

The prevalence of myopia was 10.2 %, with 7 cases (1.1%) of high myopia. We did not find any statistically significant association between myopia and the age, gender, level of education and visual complications (RR respectively 0.57, 0.39, 0.93 and 0.32). Amblyopia was observed in 6 high myopic students (0.9%) and only 1 high myopic student developed strabismus (0.1%).

Table 2: Distribution of myopia by gender, age, education level and visual complication

	Myopia	High myopia	Prevalence of myopia		p value
Gender	**N (%)**	**N (%)**	**N (%)**	**95% CI**	**0.57**
Male	21 (3.3)	4 (0.6)	25 (3.9)	[2.4, 5.4]	
Female	37 (5.8)	3 (0.5)	40 (6.3)	[4.4, 8.2]	
Total	58 (9.1)	7 (1.1)	65 (10.2)	[7.8, 12.6]	
Age groups	**N (%)**	**N (%)**	**N (%)**	**95% CI**	**0.39**
<13	0 (0)	0 (0)	0 (0)	[0, 0]	
13- 16	27 (4.2)	4 (0.6)	31 (4.9)	[3.2, 6.6]	
17- 20	26 (4.1)	3 (0.5)	29 (4.6)	[3.0, 6.3]	
21- 24	5 (0.8)	0 (0)	5 (0.7)	[0.1, 1.4]	
>24	0 (0)	0 (0)	0 (0)	[0, 0]	
Total	58 (9.1)	7 (1.1)	65 (10.2)	[7.8, 22.2]	
Education level	**N (%)**	**N (%)**	**N (%)**	**95% CI**	**0.93**
Year 1	11 (1.5)	1 (0.1)	12 (1.9)	[0.8, 3]	
Year 2	8 (1.3)	2 (0.2)	10 (1.6)	[0.6, 2.6]	
Year 3	8 (1.3)	2 (0.2)	10 (1.6)	[0.6,2.6]	
Year 4	8 (1.3)	1 (0.1)	9 (1.4)	[0.5, 2.3]	
Year 5	13 (2)	1 (0.1)	14 (2.2)	[1.1, 34]	
Year 6	10 (1.6)	0 (0)	10 (1.6)	[0.6, 2.6]	
Total	58 (9.1)	7 (1.1)	65 (10.2)	[7.8, 22.2]	
Visual complications	**N (%)**	**N (%)**	**N (%)**	**95% CI**	**0.32**
Amblyopia	0 (0)	6 (0.9)	6 (0.9)	[0.2, 1.7]	
Strabismus	0 (0)	1 (0.2)	1 (0.2)	[-0.1, 0.6]	
Total	0 (0)	7 (1.1)	7 (1.1)	[0.3, 1.9]	

Prevalence of hypermetropia was 4.3%. Furthermore, it was found no apparent risk to develop hypermetropia in all different age groups, gender, education level and visual complications (RR respectively 0.49, 0.22, 0.87 and 0.37). Amblyopia was described in one hypermetropic student (0.2%).

Table 4: Distribution of astigmatism by age, gender, education level and visual complication

Prevalence of astigmatism			p value
Gender	**N (%)**	**95% CI**	**0.92**
Male	11 (1.7)	[0.7, 2.7]	
Female	17 (2.7)	[1.4, 4.0]	
Total	28 (4.4)	[2.8, 6.0]	
Age groups	**N (%)**	**95% CI**	**0.99**
<13	0 (0)	[0, 0]	
13- 16	11 (1.7)	[0.7, 2.7]	
17- 20	14 (2.2)	[1.1, 3.4]	
21- 24	2 (0.3)	[-0.1, 0.7]	
>24	1 (0.2)	[-0.1, 0.4]	
Total	28 (4.4)	[2.8, 6.0]	
Education level	**N (%)**	**95% CI**	**0.79**
Year 1	7 (1.1)	[0.3, 1.9]	
Year 2	4 (0.6)	[0, 1.2]	
Year 3	3 (0.5)	[0, 1.1]	
Year 4	3 (0.5)	[0, 1.1]	
Year 5	7 (1.1)	[0.3, 1.9]	
Year 6	4 (0.6)	[0, 1.2]	
Total	28 (4.4)	[2.8, 6.0]	
Visual complications	**N (%)**	**95% CI**	**0.34**
Amblyopia	1 (0.2)	[-0.1, 0.4]	
Strabismus	0 (0)	[0, 0]	
Total	1 (0.2)	[-0.1, 0.4]	

Prevalence of astigmatism was 4.4%. It was found no apparent risk of developing astigmatism in all different age groups, gender and level of education (RR respectively 0.92, 0.99, 0.79 and 0.34). Amblyopia was described in 1 student with astigmatism (0.1%).

Table 5: Distribution of anisometropia by age, gender, education level

Prevalence of anisometropia			p value
Gender	**N (%)**	**95% CI**	**0.62**
Male	6 (0.9)	[0.2, 1.7]	
Female	17 (2.7)	[1.4, 4.0]	
Total	23 (3.6)	[2.1, 5.1]	
Age groups	**N (%)**	**95% CI**	**0.99**
<13	0 (0)	[0, 0]	
13- 16	9 (1.4)	[0.5, 2.3]	
17- 20	12 (1.9)	[0.8, 3.0]	
21- 24	2 (0.3)	[-0.1, 0.7]	
>24	0 (0)	[0, 0]	
Total	23 (3.6)	[2.1, 5.1]	
Education level	**N (%)**	**95% CI**	**0.79**
Year 1	5 (0.7)	[0.1, 1.4]	
Year 2	2 (0.3)	[-0.1, 0.7]	
Year 3	3 (0.5)	[0, 1.1]	
Year 4	4 (0.6)	[0, 1.2]	
Year 5	3 (0.5.)	[0, 1.1]	
Year 6	6 (0.9)	[0.2, 1.7]	
Total	23 (3.6)	[2.1, 5.1]	

Prevalence of anisometropia was 3.6%. It was found no apparent risk of developing anisometropia in all different age groups, gender and education level (RR respectively 0.62, 0.99 and 0.79).

DISCUSSION

Nyarugenge district is the second largest district of Kigali province with a population of almost third of a million (284,860people) [11]. This district is characterized by schools with improved facilities, receiving students from almost all provinces of Rwanda and all categories (low, middle and high income groups) of the population; giving a picture that could reflect figures of schools of other districts of Rwanda. Our effort in performing this study was well accepted by parents, students, educators and all stakeholders involved in education. This made our work easy as this district, like other parts of Rwanda is lacking enough number of ophthalmologists and eye care personals.

We reviewed 634 students from 13 of the 31 high schools of Nyarugenge district. These students were aged between 11 and 37 years, with a mean of 17.02 years. Majority of them (88.3%) were aged between 13 and 20 years. Wedner et al described similar findings on students of secondary schools of a Southern African region aged between 11 to 27 years and found no significant difference between refractive errors and gender [10]. We found also similarities with the study performed by Ruiz-Alcocer et al in Mozambique on prevalence of refractive error among young urban students with 53.3% of female and 46.7% of male [12]. Lian-Hong Pi et al in the study on prevalence of refractive errors in sub-urban high schools described that students were aged between 5 to 15 years with a mean age of 10.41±2.73 years and an equal distribution of gender [13]. In the study by Naidoo K et al on refractive error and visual impairment in African children in South Africa described an equal distribution of gender [14]. However, this study result was not directly comparable with the current study, as it was population based. Megbelayin et al. found similar findings on pattern of refractive astigmatism in Nigerian high schools with students aged between 9 and 21 years, mean age of 13.86±1years and an equal distribution of gender [15]. Results of our study are not in agreement with some studies. The Pakistan study on prevalence of refractive error in school children of Karachi showed different finding with a mean age of 9.49±2.5 years and an association between refractive error and female gender distribution [16]. However no association was observed with age, ethnicity, parental education and other risk factors. Many studies described refractive error as a common problem in young people influenced by different factors: by age (Son et al, 2006), gender (Murthy et al, 2002), near work (Saw, 2003), ethnicity (Saw, 2000) and environmental factors (Lian-Hong et al, 2010) [17 18 19 20 13]. Although there were more female (56.6%) than male (43.4%) in our study, there was no statistically significant difference (p=0.49) between gender and refractive error. Most of studies described no difference between female and male [10]. This distribution of gender in our setting could be related to the general Rwandan population distribution with more female than male [11]. Free primary education based initiative and women empowerment initiative by the Rwandan government could also explain more female than male in these schools. However enlarged studies

on refractive error could give more explanation on this finding. Majority of students were from Nyarugenge district, however many student came from almost all regions of Rwanda. Results of this study will give more light on the pattern of refractive errors which is the first step toward a more comprehensive survey on districts in Rwanda.

Although studies have been conducted in various countries on prevalence of refractive errors, most were performed in settings of unknown representativeness, with different measurement methods and non-uniform definitions; providing difficulties in comparisons across study reports [21]. Additional to this, the availability of eye care personnel in developing countries, especially in Africa is still a big problem; its poor distribution across the continent made it even worse in term of providing efficient eye care services at large and refractive error care service accessible and affordable [14]. All these factors give the opportunity of looking at this refractive error issue with a more comprehensive approach.

The study performed in our setting provides reliable evidence that prevalence of refractive error common in high schools of Nyarugenge is high (18.9%). It also found no relation between the overall refractive errors and the age, gender and level of education of students. Many studies described lower prevalence of refractive errors compared to our findings. A study on prevalence of refractive errors in high school students in Kaduna, Nigeria mentioned 2.4% [15]. Studies conducted in Pakistan revealed that the prevalence of refractive error varies from 1 to 8% [16]. Dandona et al described 9% of refractive errors in children of a rural population in India [22]. In the study on refractive error in children from Shunyi District, China, Zhao J et al found lower prevalence of 12.8% [23]. Maul E et al studied refractive error on children from La Florida, Chile and found a prevalence similar to ours (15.8%) [24]. However some of these studies findings are not directly comparable with the current study, as they were population and not school based. In the study on prevalence of refractive error and visual impairment in African children in South Africa, Naidoo KS et al described higher prevalence of refractive error (63.6%) with 7.3% of amblyopia [14].

From a total number of 120 students with refractive errors, only 32 (26.7%) were wearing spectacles. Majority of these students were ignoring the importance of wearing glasses. Furthermore, many of them were not aware about the risk of reduction of vision in case of lack of appropriate corrected spectacles, especially in case of high refractive errors. The proportion of students not wearing glasses was found higher than that of many studies: in rural China, the problem of uncorrected refractive error appeared to be particularly severe, where 40% to 60% of secondary school children were myopic, but nearly two thirds were without the necessary spectacles to improve vision [25]. In sub-urban Chile, 50% of high school students in need were not wearing spectacles [24]. Wedner SH et al described 30.3% of students with refractive errors wearing spectacles in secondary school of Mwanza, Tanzania [10]. Although many studies showed differences in prevalences, majority of them showed high percentage of subjects not wearing spectacles and ignoring the impact of this on their vision. There is a need of educating our people about effective strategies toward better management of refractive errors by providing school-based vision screening, quality optometric services, and affordable spectacles.

The prevalence of myopia was 10.2%, representing the most important refractive error. Amblyopia was observed in 6 high myopic students (0.9%) and only 1 high myopic student developed strabismus (0.1%). Furthermore, there was no apparent risk to develop myopia in all different age groups, gender and education level. Many studies described myopia as the leading refractive error, with a wide range of prevalence [12]. This prevalence was lower compare to a range of reported studies: 73.9% described by Timothy Q et al on the prevalence of myopia in teenager high school students in Singapore; 21.7% of myopia in Tibetan children who led an urban lifestyle, including more rigorous schooling [26, 27]. However, it was considerably higher than some African and Asian studies: the reported study on prevalence of myopia in secondary school students in Kaduna, Nigeria, with a prevalence of 2.4% for myopia; the prevalence of 4.3% of myopia among schoolchildren in Northeastern Iran [21]. Wedner SH et al. also described myopia as the leading refractive error (5.6%) in secondary schools of Mwanza, Tanzania with 0.4% of Amblyopia and 0.2% of strabismus [10]. The prevalence of hypermetropia was 4.4%. It was found no apparent risk to develop hypermetropia in all different groups, gender and education level. Prevalence of hypermetropia in our setting was higher than that of many studies: 0.3% in the study performed by Robert Lindfield in Bangladesh, 1% in the study on prevalence of refractive errors in school children of upper-middle socioeconomic status in Kathmandu [28]. Prevalence of this study was similar to that described by the Iranian study equivalent to 5.4 % and 4.8% in the study on prevalence of refractive error in young urban students in Mozambique [21, 12]. Astigmatism was found in 3.6%. Relative risk test found no apparent risk of developing astigmatism in all different age groups, gender and education level. This was lower than 4.9% on right eyes and 5.2% on left eyes on students in Kathmandu study, Nepal [29]. Amblyopia was observed in 13 students (12%) and 4 students had strabismus (0.6%). These two complications resulted from lack of proper correction of refract ioncarried out in schools for the blind have also reported that uncorrected myopia and aphakia were responsible for 3% of the blindness among blind-school children in Zimbabwe, while uncorrected aphakia and amblyopia were responsible for 5.1% of the blindness among blind-school children in India [30]. High percentages of these complications highlight the importance of educating our people about earlier and proper correction of refractive errors.

CONCLUSION

The prevalence of refractive errors in high schools of Nyarugenge district was high; myopia was the most important. There were more female than male, however no statistical difference was observed. No statistically significant differences were found between refractive errors in all age group, gender and education level. Only one third of students with refractive errors were wearing glasses. The main reasons of not wearing spectacles were lack of awareness and high cost of spectacles.

Prevalence of refractive errors in high schools of Nyarugenge was high. We recommend the education of our population about this condition so that early

presentation and proper spectacle corrections can be performed at eye care service levels. There is a need of having low cost spectacle services through Government, Non-Governmental Organizations or other partners in health. Human resources development and provision of equipment are also important recommendations for proper management of refractive errors.

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