INTRODUCTION

The aetiology of refractive errors is still unclear and is probably multi-factorial. Several factors as age and ethnicity have been studied to understand the origin and development of refractive errors but principally environmental and genetic factors represent the most of the current efforts to understand the aetiology of refractive errors. Instead of the researches that is possible to find in literature, today is not determined the exact contribution of these two components. Twin studies, with controversial results, have been developed to clarify the importance of genetic or environmental factors in refractive errors.

The results of prevalence of refractive errors among populations in the world show a high variability. Some Asian countries as Singapore, China or Taiwan present levels of myopia that are considered quasi-endemic. At the same time some population from Nordic countries in Europe, presents myopia’s prevalence higher than 30%. Refractive errors in North-America and Australia are also well documented and it is possible to find studies with levels of 33.1% and 17% of myopia respectively. In contrast to these data, other study obtained data of myopia near to 5% in an Ecuadorian group.

Data regarding refractive status in Africa is lacking. This report shows details of the refractive status of the urban, university student population in Mozambique.
Knowledge about the refractive status of populations with ethnic and socio-cultural specificities such as the one we surveyed are of interest in order to reinforce our understanding of the aetiology of refractive error and to established programs focused on the improvement of the visual health of these unattended populations.

The aim of this study was to report the prevalence of refractive errors in the Mozambican, urban, university population. To the best of our knowledge this is the first study providing data about refractive status of students in Mozambique.

MATERIALS AND METHODS

According to the student census, available from the Instituto Nacional de Estatística de Mozambique, an academic centre of superior education in the city of Maputo was chosen by chance. The current study was carried out at the beginning of 2008/2009 academic course, with a sample of 422 subjects (197 males and 225 females) between 17 and 26 years (23.00 ± 2.18 years). According to the estimations of Krejcie and Morgan (1970) the sample represents the whole population of young-adult students of superior education that lives in urban areas in Mozambique considering a population of 40.000 students in the surveyed age range13. All the students of the centre were invited by an official announcement to participate in the study few weeks before the beginning of the study.

Exclusion criteria were to have active or past eye injury or disease that could affect the visual function (e.g.: trachoma, retinal diseases, cataracts, corneal opacities, etc.). Uncorrected visual acuity, ophthalmoscopy and external examination were performed to discard these ocular conditions. Uncorrected visual acuity was measured using ETDRS distance visual acuity chart placed at 4 meters under standard lighting conditions. Three subjects were excluded from the study, one of them due to congenital cataracts in both eyes and two of them due to irreversible severe visual loss of unknown aetiology.

Local authorities (Instituto Superior de Ciências da Saúde de Maputo) gave their consent to conduct the study, as well as any individual participating in the study once all the methods, benefits and potential risks have been explained. The tenets of the Declaration of Helsinki were followed in this study.

After the first part of the examination, non-cycloplegic static retinoscopy and non-cycloplegic subjective refraction were conducted. Retinoscopy value was used as starting point for the subjective refraction and refining it until the subject’s visual acuity was at least 20/20 or better14. Criterion of maximum plus for best visual acuity was followed to determine the sphere. Cross-cylinder technique was used to accurately determine the axis and amount of astigmatism. Sphero-cylindrical refractive error was expressed by 3 powers vectors: M, J0, J45, with M being a spherical lens equal to the spherical equivalent (SE) of the given refractive error and J0 and J45, being 2 Jackson cross-cylinders equivalent to the conventional cylinders15. Each of the 3 values is a coordinate of a point in a 3-dimensional dioptric space representing the power vector originating from the origin of the space to that point. Manifest refraction in conventional script notation [S(sphere), C(cylinder) x α(axis)] were converted to power vectors coordinates by the following formulas: M=S+C/2; J0=(-C/2)cos(2α); J45=(-C/2)sin(2α).

For this report, the different criteria to define the refractive status were myopia, hyperopia and emmetropia. The cut-off point was chosen at M=–0.50D for myopia and +0.50D for hyperopia, both included. Emmetropia was considered from for M>–0.50D and <+0.50D6.

Data were analyzed using SPSS for Windows v.17.0 (SPSS Inc, Chicago, IL). Normal distribution of variables was assessed using Kolmogorov-Smirnov test. Due to the lack of normality of the refractive data, non-parametric tests were used (Kruskal-Wallis and Wilcoxon test) to gauge any statistically significant difference of refractive data as a function of age and gender.

RESULTS

High correlation between eyes (Spearman’s Rho = 0.765) were reported, hence only the right eye of each subject was used for subsequent analysis in order to avoid data duplication that could affect the significance of results16. Gender distribution of population presented in this study is listed in table 1.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Myopia ≤ -0.50 n (%)</th>
<th>Emmetropia &gt;-0.50 and &lt;+0.50 n (%)</th>
<th>Hyperopia ≥ +0.50 n (%)</th>
<th>Sample n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>28 (6.6)</td>
<td>162 (38.4)</td>
<td>7 (1.7)</td>
<td>197 (46.7)</td>
</tr>
<tr>
<td>Female</td>
<td>27 (6.4)</td>
<td>185 (43.8)</td>
<td>13 (3.1)</td>
<td>225 (53.3)</td>
</tr>
<tr>
<td>Total Population</td>
<td>55 (13.0)</td>
<td>347 (82.2)</td>
<td>20 (4.8)</td>
<td>422 (100)</td>
</tr>
</tbody>
</table>
The prevalence of refractive errors as a function of gender and for the whole population is also presented in Table 1. Frequency distribution of refractive errors in the whole population defined as spherical equivalent is presented in Figure 1. The distribution of the refractive error as per the subjective refraction shows an approximation of this particular population to the emmetropia. The vast majority of subjects in all groups were emmetropic (82.2%).

The mean value of spherical equivalent (M) of the whole sample was -0.16D±0.44, being -0.16D±0.43 for males and -0.15D±0.45 for females. The J0 component for the total sample was 0.02±0.15. The J0 component was 0.02D±0.16 and 0.03±0.15 for males and females respectively. The J45 component was 0.00D±0.07 for the whole sample, and was 0.01D±0.08 for males and -0.01D±0.07 for females. No statistically significant differences were detected in spherical equivalent (M) by gender (p=0.962, Wilcoxon signed ranks test). There were no statistically significant differences in J0 and J45 components between gender groups (p=0.010, p=0.345 Wilcoxon signed ranks test).

DISCUSSION

The results of our study provide data about the refractive status in a particular population of Mozambique and shows that the prevalence of refractive errors in the young university population in Mozambique is low when compared with other student populations in Europe, Asia or America. The results show a high prevalence of emmetropia (82.2%) and low prevalence of myopia (13.0%) and hyperopia (4.8%), but it’s important for the authors to take into account that there’s also a low mean refractive error (–0.16 ± 0.44D) showing an approximation of the whole population to emmetropia, as shown in Figure 1. The current study shows also the average of the mean spherical equivalent refractive error and the difference between gender groups. The association of gender with refractive error has not been well established. Some of the previous studies have shown that there are differences between biometric ocular parameters between men and women17,18. Hence, there would be a correlation between gender and refractive error. But most studies found no difference of refractive errors between male and female groups11,19,20. Similarly, our study doesn’t indicate a significant difference between males and females (p=0.962). However, to our knowledge there are not previous reports that measured biometric ocular parameters in a sub-Saharan population in the range of age from 17 to 26 years. For that, we consider that future studies should be carried out to assess ocular parameters in similar populations.

Present study is similar to those published by Wedner et al. (2002)21 and Lewallen et al. (1995)22, in which students of secondary schools of a Southern African region between 11 to 27 years, and 7 to 19 years respectively, were examined. Even if the results of the current study are relatively consistent with the one of Wedner et al. (2002)21, is difficult to compare both studies due to the different range of age under study.

At the same time we want to note that even if the prevalence of myopia in this Mozambican population is low (13.0%), other similar populations of the southern African region present lower levels of myopia (see Table 2). It is important to report that the sample of the current study is composed of university students between 17 and 26 years, for that, it is possible to consider that the role of near work and high education could make some impact in these African populations. This consideration makes more important the development of sustainable resources to continuously monitoring data for the refractive status among the populations of these regions.

In spite of the numerous studies documenting the prevalence of refractive error, the aetiology of these ocular conditions remains relatively unknown. Several factors explain differences in the expression of refractive error including age, gender, environmental conditions, genes, rural vs urban environment, socioeconomic conditions, etc.3. As we mentioned before, other factor that has been addressed in different works is the influence of near work in myopia. The results show a direct relation between time spent on near-work and myopia onset or progression23-25, thus, this consideration is important when populations under a high demand of educational activities are studied. The relationship between ethnicity and refractive error has been also studied. A slight number of studies present data of refractive errors in African countries, however,
it's possible to find in the literature different studies that offer data of different black populations (African-American). These studies present values of refractive error and relate this condition with ethnicity. The results presented in these researches demonstrate a lower prevalence of refractive errors in black populations compared with other ethnic groups\textsuperscript{2,26,27}.

All of these studies have also helped to understand with accuracy the visual health status of some populations and to develop programmes to improve the quality of life of the members of these communities. Several studies report the importance of these programmes and present a list of actions to carry out in the poorest regions of the world\textsuperscript{28,29}.

In some Asian countries as China or Singapore it is possible to find a huge amount of research work on refractive error, ocular parameters, ocular diseases, ocular health status, etc. Conversely, there are other populations in which just few studies had been conducted in the last years, while others have never been surveyed. An example of an important lack of data about visual health status and refractive errors is one the poorest regions of the world such as Mozambique in the Southern Africa. There are studies that present data of refractive errors and the visual health status in a single country that is Tanzania\textsuperscript{21,30}, for the rest of the countries of the Southern Africa the researches are scarce. In some countries as Swaziland, Namibia or Mozambique no studies exists, and in other countries as Lesotho, Malawi, Zambia, Madagascar or Botswana, just few studies have been carried out long time ago and no all of them have directly investigated refractive errors\textsuperscript{22,31-34}.

However, accurate data for the refractive status of this region would be necessary. In fact, several international organizations are incentivizing for collecting and monitoring of refractive error data within the poorest regions of the world due to the fact that uncorrected refractive errors have been demonstrated to be one of the main causes of blindness in those countries\textsuperscript{28,29,35}.

Table 2 summarizes data regarding age of participants and prevalence of myopia for different African regions. Different studies analyzing Asian, European and American populations are also reported for comparison purposes.

The use of non-cycloplegic refraction can be considered as a limitation of the study. However, given the age of the participants and the careful objective and subjective refractive procedures conducted, it is not expected that the results changed much from those reported here. This is supported by recent publications\textsuperscript{14-36}. In spite of the limitations of the study, the conclusion is that the current work shows that the prevalence of refractive error in the population studied is low. At the same time we want to highlight that this study is the first report about the prevalence of refractive errors in Mozambique establishing a valuable profile to develop future studies.

REFERENCES

3. McBrien NA, Young TL, Pang CP, et al. Myopia: Recent advances in molecular studies; prevalence, progression and risk factors; emmetropization; therapies; optical links; peripheral refraction; sclera and ocular growth; signalling cascades; and animal models. Optom Vis Sci. 2008; 86: 45-66.


