ECRONICON OPEN ACCESS

EC OPHTHALMOLOGY
Research Article

Pattern of Refractive Error among Elementary School Students in Jimma Town South West Ethiopia

Dagmawit Kifle[1]*, Kumale Tolosa[1], Jafer Kedir[1], Aemero Abateneh[1] and Melese Sinaga[2]

[1]*Department of Ophthalmology, Jimma University, Ethiopia*
[2]*Department of Nutrition and Dietetics, Jimma University, Ethiopia*

***Corresponding Author:** Dagmawit Kifle, Department of Ophthalmology, Jimma University, Ethiopia.

Received: August 10, 2021; **Published:** November 30, 2021

Abstract

Background: The World Health Organization has reported 153 million people with visual impairment due to uncorrected refractive errors, of whom 13 million are children. There are limited studies in Ethiopia on the prevalence of refractive error.

Methods: The aim of this study was to determine the prevalence of refractive errors and classify the frequency of the various types of refractive errors among children attending Jimma elementary school, using cross-sectional design. A total of 289 students were selected randomly by Multi stage sampling technique. Pretested, structured questionnaire used to collect data and SPSS version 20 for analysis. Multivariable logistic regression model was used to isolate independent factors associated with refractive error. Data was presented using tables and graphs.

Result: Among 289 participants, refractive error was diagnosed in 6.92% of the students. Factors with significant association were; Family history (AOR = 4.65 and 95% CI 1.291 16.800 and P = 0.019), reading at a distance closer than 38cm (AOR = 95% CI 3.304 1.195 9.134 and P value of 0.021), time of reading 2 hours or more, (AOR = 5.773, 95% central tendency 1.195 9.134) and being from literate parents (AOR = 5.085, 95% CI 1.105 23.400 and P value of 0.037).

Conclusion and Recommendation: - The prevalence of refractive error in elementary school children of Jimma town was high.

Keywords: *Amblyopia; Refraction; Visual Acuity; Visual Impairment; Refractive Error and Schoolchildren*

Abbreviations

AA: Addis Ababa; AOR: Adjusted Odds Ratio; COR: Crudes Odds Ratio; CI: Confidence Interval; Cm: Centimeter; Hr: Hour; Km: Kilometer; MYP: Several Myopia Loci; RE: Refractive Error; SPSS: Statistical Package for Social Sciences; TV: Television; WHO: World Health Organization

Introduction

As the World Health Organization (WHO) reported, 153 million people have visual impairment due to uncorrected refractive errors. Among them, eight million are blind and 145 million have low vision. Out of the 153 million, 13 million are children, 5 - 15 years of age while 45 million working age adults, 90% of these are living in low and middle income countries [1,2].

The impact of blindness due to refractive error in children results in a greater socioeconomic burden on society more than the impact of cataract blindness in old age. Uncorrected refractive errors have severe consequences for the individual, family and society. Myopia in particular, can have an impending negative impact on career choice, ocular health, and sometimes self-esteem. School-aged children constitute a special vulnerable group, where uncorrected refractive error may have a remarkable impact on learning capability and educational potential, as well as economic cost to the family and government [3,4].

It remains particularly difficult to compare the prevalence of refractive error in different geographic areas for a number of reasons: definitions of emmetropia, myopia and hyperopia are not uniform across studies; procedures used to assess refraction status are different (refractions may have been performed with or without cycloplegia); and the demographic makeup of the studied populations is often dissimilar (age and sex composition in particular) [5].

The main objective of this study was to determine the prevalence of refractive errors and classify the frequency of the various types of refractive errors among children attending Jimma elementary school.

Many studies have demonstrated a correlation between age and myopia in the second decade of life. On a cross-sectional study done on the prevalence of refractive errors among schoolchildren in Dezful, Iran, prevalence of myopia has increased from 7.1% in the 6 - to 7-year-old age group to 22.6% in the 14 - to 15-year-old age group [6].

A cross-sectional school based study done in China on Grade 10 and 11 high school students revealed prevalence of myopia to be higher than other types of refractive error. With this young myopic generation getting older, myopia as cause for visual impairment and blindness may further increase in importance [7].

In India, prevalence of refractive error is assumed to be 13.09% of the children, out of which 5.72% are boys and 7.36% are girls [6]. In comparison to urban and rural India, prevalence of uncorrected refractive error is 5.46% in urban and 2.63% in rural children [8].

In Nepal, refractive error was found in 32.0% of elementary school children [7]. In Saudi Arabia according to the study done in primary school children, the overall prevalence of refractive errors was 13.7%, higher among females [9]. In Brazil, in school children the prevalence of uncorrected refractive error was 4.82% [10].

Among African countries; there was a screening study done in Egypt to determine the prevalence of refractive error among schoolchildren and found the prevalence of RE to be 22.1% [11]. In a study done in southeast Nigeria post primary school in rural community, the prevalence of refractive error was found to be 1.97% and myopia was the most common type of refractive error found [12].

Ethiopia is one of the developing countries in Africa, with poor health service coverage especially eye health care and is believed to have one of the world's highest rates of blindness. For the eradication of avoidable blindness, refractive error has been highlighted in the global initiative, vision 2020. In Ethiopia, refractive error is the second (33%) leading cause of low vision preceded by cataract [13].

According to the national survey on blindness, low vision and trachoma in Ethiopia' that was conducted in 2005- 2006, the prevalence of blindness in Ethiopia was 1.6% and that of low vision (vision < 6/18) was 3.7%. But it didn't give emphasis for prevalence of refractive error in children [14].

The prevalence of visual impairment due to refractive errors in school children in Debark and Kola Diba, northern Ethiopia, was 7.6%, myopia being the most dominant [3].

In another study, which was done in Gondar town northwestern Ethiopia, the overall prevalence of refractive error was 9.4%. The high prevalence of refractive errors among school children indicates the need for regular school-screening programs [15].

In This study the prevalence of refractive error was assessed and the frequency of the various types of refractive errors was classified among children attending Jimma elementary school.

Significance of the study

Blindness due to refractive error can hinder education, personality development and career opportunities. It is also responsible for more blind years as compared with cataract. As only few studies are done on this issue in Ethiopia in some schools; this study can be used as a baseline for further studies, screening program in school for refractive error and development of management plans and policy.

Methods and Materials

A cross-sectional study was performed on students in Jimma elementary schools from March up to April 2018. Jimma is located in the southwest of Ethiopia and Western Oromia region, 352 km far from the capital city, Addis Ababa (AA). According to Jimma Town Health office, the estimated total population of Jimma town for 2009 E.C was 174,778. Out of these 87,879 of them were male while 86,999 of them were female. There are 23 (1 - 8) elementary schools, 5 high schools, 3 preparatory schools, 2 technique schools, 8 private collages and 1 university.

Multi stage sampling technique was used to get the study population from each grade according to their proportion using list of the students. Design factor of 2 and non-response rate of 10% was used. Six schools were selected randomly out of 21 government elementary

schools in Jimma town. The number of students for each school was assigned according to the proportion to size of students in the respective schools. Proportional allocation of samples was made for each sex in each school. A simple random sampling by computer generated random numbers was finally used to identify study subjects. Students or parents who were not willing to participate in the study were excluded.

Pretested, structured questionnaire was used to collect data. Visual acuity was measured in the school compounds in well-lighted class rooms using the snellen E chart. Pinhole and cycloplegic refraction was performed for those who had visual acuity less than and equal to 6/12.

The data collected was entered into Epi data version 3.1 and was exported to SPSS. It was cleaned and coded using SPSS version 20.0 for analysis. Descriptive statistics (frequencies and percentages) was computed to show the picture of the data. Binary logistic regression was used to detect the association between each independent variable and the dependent variables. Variables with $p \leq 0.25$ in the bivariate analyses were taken as candidates for multivariable regression analysis to control for confounding variables. Those variables having a p-value < 0.05 in multivariate logistic regression was considered as significant association with dependent variable.

Results and Discussion

Out of the total of 289 students that participated in the study 173(59.9%) were females and majority of the students were in the age group of 11 - 19 years 189 (65.4%). Regarding their grade, 153 (52.9%) of them were learning 5 - 8 grade. Among the 289 students, 162 (56.1%) had average grade score of 61-80 (Table 1).

Socio-demographic characteristics	No. (%)
Sex	
Male	116(40.1%)
Female	173(59.9%)
Age in years	
5 – 10	100 (34.6%)
11 – 19	189 (65.4%)
Ethnicity	
Oromo	233 (80.6)
Amhara	17 (5.9)
Dawuro	14 (4.84)
Kulo	13 (4.5)
Other*	12 (4.2)
Place of residence	
Rural	23 (8%)
Urban	266 (92%)
Occupation	
Famer	26 (9.0%)
Merchant	98 (33.9%)
Government employee	116 (40.1%)
Daily Laborer	24 (8.3%)
Do not have work	25 (8.7%)
Grade	
1 – 4	136 (47.1%)
5 – 8	153 (52.9%)
Average semester point	
<40	13 (4.5%)
41-60	46 (15.9%)
61-80	162 (56.1%)
81-100	68 (23.5%)

Table 1: *Socio-demographic characteristics among elementary students in Jimma town from March up to April 2018.*

According to this study, out of the 289 student 20 (6.9%) of them had family history of use of eyeglass for correction of reduction of vision. Among the 289 students 177 (61.2%) spend their reading 2 or more hours in a day by studying. The reading distance commonly used was > = 38 cm by 231 (79.9%) of the students and 152 (52.6%) of the students had resting time in between for their eyes by looking far. This resting period in 168 (58.1%) of the students was for > = 1 minute while for 121 (41.9%) it ranges between 20 seconds and 1minute.Regarding the time they spend on TV watching, 134(46.4%) spend 1 - 3 hours, 73(25.3%) of the students have < 1 hr and few students spend more than 3hr watching TV (Figure 1).

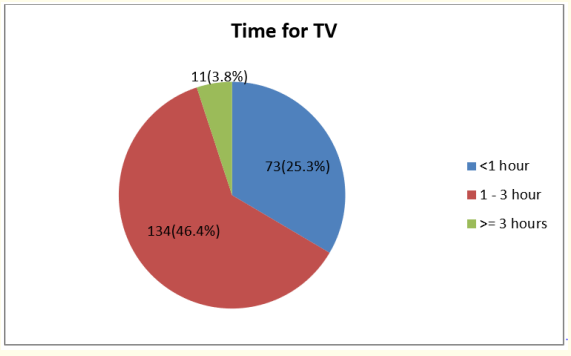

Figure 1: *Time spent on watching TV by Jimma elementary students.*

Only 4 (1.4%) of the students get access for computer and use it for not more than an hour. Out of these, 3 of them use it at distance between 41 - 55 cm and one of them at > 55 cm. The number of students that spend their free time by playing videogame was 72 (24.9%). Students that participate in outdoor play were 205 (70.9%) and among them, 126 (43.6%) spend 1 – 3 hours of their time on it. Students that have time for physical exercise were 55 (19%) (Table 2).

Video game	**No (%)**
No	217 (75.1)
Yes	72 (24.9)
Computer use	
No use	285 (98.6)
Yes	4 (1.4)
Outdoor play	
No playing	84 (29.1)
Yes	205(70.9)
<=1hr	61 (21.1)
1 - 3hr	126 (43.6)
>=3hr	18 (6.2)
Physical exercise	
No	234 (81.0)
Yes	55(19)
<=1hr	38 (13.1)
1 - 3hr	17 (5.9)

Table 2: *Number of elementary students in Jimma town participating in video game; computer use; outdoor play and physical exercise.*

According to the findings of this study, out of the 289 students participated in the study, 28 students had visual acuity worse than 6/12. Among them, refractive error was the cause of low vision in 20 (71.4%) students. Among the students with refractive error, 9 (45%) of them were having myopia, 6 (30%) of them were diagnosed to have hyperopia while the rest 5 (25%) were having astigmatism (Figure 2). This makes the prevalence of refractive error to be 6.92%. When we see the prevalence of each type of refractive error, myopia accounted to be 3.1%, hyperopia 2% and astigmatism 1.73%. Among the students with RE only 2(0.7%) were using correcting eye glass.

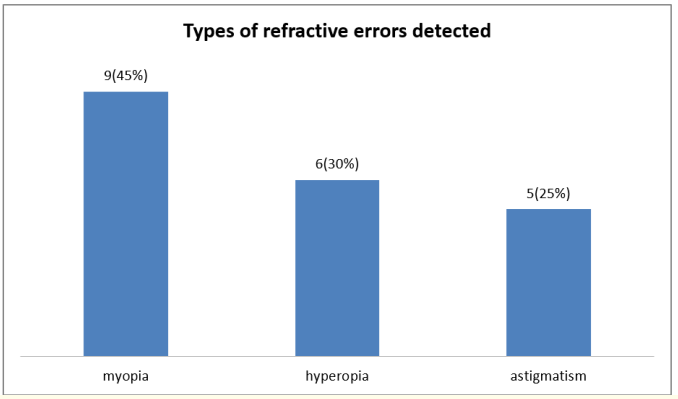

Figure 2: *Types of refractive errors detected among elementary students in Jimma town.*

Regarding the severity of the different types of refractive errors majority of the students were having mild form of refractive error. In myopia among the nine 5(55.5%) of them had mild myopia and 3(33.3%) of the myopia was moderate (Figure 3).

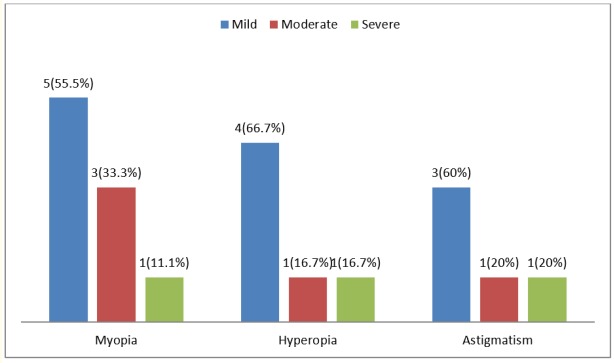

Figure 3: *Severity of different types of refractive errors in Jimma elementary students.*

According to the bivariate analysis, near reading distance, parents literacy, longer time of reading and family history of refractive error were risk factors for development of refractive errors in the study participants were among candidates for multivariate analysis having P value < 0.25.

On the multivariate analysis, students with family history of refractive error had 5 times more risk to have refractive error with P value of 0.019 (AOR = 4.65 and 95% CI 1.291 16.800). Reading at a distance closer than 38cm had 4 times increased risk for refractive error with P value of 0.021;(AOR = 95% CI 3.304 1.195 9.134). Time of reading 2 hours or more is significantly associated with development of RE by 6 times increased risk (AOR = 5.773, 95% central tendency 1.195 9.134). Regarding the literacy status of the parents, being from literate parents has 5 time increased risk for the development of refractive errors with P value of 0.037 (AOR = 5.085, 95% CI 1.105 23.400) (Table 3).

Predictors	Refractive Error		Cor	Aor	95% Ci		P
	YES	NO			LOWER	UPPER	
Family history							
Yes	5(25.0%)	15(75.0%)	5.644	4.658	1.291	16.800	0.019
No	15(5.6%)	254(94.4%)	1				
Reading distance							
<38cm	9(15.5%)	49(84.5%)	3.673	3.304	1.195	9.134	0.021
>= 38cm	11(4.8%)	220(95.2%)	1				
Time of reading							
<2hrs	2(1.8%)	110(98.2%)	1				
>=2hrs	18(10.2%)	159(89.8%)	6.226	5.773	1.278	26.086	0.023
Parent literacy							
Yes	18(10.8%)	149(89.2%)	7.248	5.085	1.105	23.400	0.037
No	2(1.6%)	120(98.4%)	1				

Table: 3 *Multivariable logistic regression model predicting the likelihood of refractive error elementary students in Jimma town from March up to April 2018.*

Discussion

The result of our study has showed the prevalence of refractive error among elementary school children in Jimma town to be 6.92% and myopia has accounted to be 3.1%, hyperopia 2% and astigmatism 1.73%. In Iran, study done on school children aged 6- to 7-years of age showed prevalence of Myopia to be 7.1%. According to a study done in Uganda, the prevalence of refractive error among children in lower primary schools was found to be 11.6%. Astigmatism was commonest type which accounted for 52%; followed by hypermetropia and myopia was the least common (16). In Cairo a screening done in elementary schools has revealed higher prevalence of RE (22.1%) compared to our result. Of the children with RE, 55.7% were myopic, 27.3% hypermetropic and 17.0% astigmatic.

This difference in prevalence of refractive error and each types of refractive error could be due to difference in genetics and environment; different interpretation of results, due to different method of refraction or due to sample size difference.

Our finding is more or less similar with the other studies done in different parts of Ethiopia. For instance: Prevalence of refractive errors among school children aged 6-18 years in the city of Addis Ababa; Ethiopia was studied and found it to be 4.0%. Of this myopia was found to be higher, 26.7% of cases, followed by astigmatism 17% of cases [17]. In Gurage zone, Goro district, the prevalence of refractive error among rural school-aged children was 3.5% (myopia 2.6% and hyperopia 0.9%) [18]. In Gondar prevalence of refractive error in elementary school students was found to be 4.9%.Hyperopia was common in the age group between 5 - 9 years while for 10 - 14 year olds, myopia was more common [19].

In our study positive family history had 5 times higher risk for having refractive error. Robert Wojciechowski and Nathan Congdon had studied on Heritability of Refractive error and Familial aggregation of myopia in an elderly American population. They found heritability of refractive error to be 61% and was estimated as twice the residual between sibling correlation after adjusting for age, gender and race [20]. In a twin-pair study, Hammond etal.14 reported a heritability estimate for refractive error of between 84% and 86% [21]. Family

linkage studies i had identified several myopia loci (MYP-1 to -12) for a range of myopic severities. These were in support for a genetic origin of myopia in addition to environmental risk factor, like near work [22]. A study on ethnic Chinese in Taiwan show an increase in the prevalence and severity of myopia over the span of 2 generations, which implies that genetics alone are not entirely responsible for myopia [23]. A report from China showed the refractive error difference between parents and their children and its possible risk factors. The children's spherical equivalent was predicted to approach the parental by the age of 14 years of age. This mirrors the increasing prevalence of myopia in the younger generation, which is may be due to changes in life style and environmental exposure [24].

According to our study, reading at a distance closer than 38cm had 4 times increased risk for refractive error. It is estimated that about 20% - 40% of patients with low hyperopia or emmetropia who have extensive near-work requirements become myopic before age 25, compared with less than 10% of persons without such demands. It has been theorized that persons who regularly perform considerable near work undergo a process similar to emmetropization for the customary close working distance, resulting in a myopic shift [25]. Among 210 Chinese children 8 - 9 years old, Saw., *et al*. reported that myopic children performed more total near work activities than non-myopes [26].

Regarding duration of near work, reading for 2 hours or more had 6 times increased risk for development of refractive error. Refractive error data from a school screening survey program in Bhanpur, India had showed that a short duration of outdoors activities is among other factors associated with the prevalence and incidence of refractive error in children [8]. A study done on refractive error in school children in Vietnam has showed that, increased reading hours and computer hours were associated with myopia and increased outdoor hours had a protective effect for myopia (38%). Khader., *et al.* also reported that the odds of having myopia increased by 24% and 16% for each additional 1 hour spent on writing/reading and computer work outside of school, respectively [27].

As our result suggested, being from literate parents will increase the chance of having refractive error and the major type of refractive error was myopia. Parental myopia was shown to be associated with the increased risk of myopia in children which is associated with increased near work activity. Since literacy indirectly shows increased time of reading; these types of people are at risk for myopia. Singh H, Saini VK, have found that, level of parental education and region of habitation, a major factor associated with the prevalence and incidence of refractive error specially myopia in children [8].

Conclusion

Refractive error is one of the major causes of visual impairment in Jimma elementary school students. However, only few students were diagnosed and were using refractive error correction glasses.

Agreeing to the present educational policy on primary education for all children, school assessment in town explains the problem at community level and it also helps to assess impact of refractive error on learning capability and educational potential.

To control causes of blindness in children, simple vision-screening examination should be under taken in all schoolchildren. For those who have a significant refractive error, appropriate corrective glasses should be prescribed. This is also one of the targets for VISION 2020.

Acknowledgements

We would like to thank the participants of the study for their cooperation and light for the world for provision of the necessary materials for the study. Our highest appreciation also goes to JUDO's optometrist who participated in the data collection and JU for giving us ethical clearance.

Conflict of Interest

The authors have no conflict of interest.

Bibliography

1. Resnikoff S., *et al*. "Global magnitude of visual impairment caused by uncorrected refractive errors in 2004". *Bulletin of the World Health Organization* 86.1 (2008): 63-70.

2. World Health Organization. Global Initiative for the Elimination of Avoidable Blindness: action plan 2006-2011 (2007).

3. Preslan MW and Novak A. "Baltimore vision screening project". *Ophthalmology* 103 (1996): 105-109.

4. Kassa T and Alene DG. "Prevalence of refractive errors in pre-school and school children of Debark and Kola Diba towns, North-western Ethiopia". *The Ethiopian Journal of Health Development* 17.2 (2004): 117-124.

5. Zoe Weizihi Gao. "Refractive error in children in Cambodia and childhood blindness in Sri Lanka (2011).

6. Fotouhi A., *et al*. "The prevalence of refractive errors among schoolchildren in Dezful, Iran". *British Journal of Ophthalmology* 91.3 (2007): 287-292.

7. Podhye AS., *et al*. "Prevalence of uncorrected refractive error and other eye problems among urban and rural school children". *Middle East African Journal of Ophthalmology* 16.2 (2009): 69-73.

8. Singh H., *et al*. "Refractive error in school going children data from a school screening survey program in Bhanpur, Bhopal". *National Journal of Community Medicine* 4.1 (2013): 138-140.

9. Pant BP., *et al*. "Refractive status among the students presenting in Geta eye hospital khailali Nepal". *Nepal Medical College Journal* 12.2 (2010): 95-99.

10. Wadani FA., *et al.* "Prevalence and pattern of refractive error among primary school children in Al Hassa Saudi Arabia". *Global Health Sci Saudi Arabia* 5.1 (2013): 125-132.

11. Nassar EA. "Refractive error among primary school children". *Bulletin of the Ophthalmological Society in Egypt* 91 (1998): 447-449.

12. CM. Chuka – Okasa, refractive errors among students of post primary institution in a rural community in South - Eastern Nigeria". *WAJMVOL* 24.1 (2005).

13. Gilbert E., *et al.* "Prevalence of visual impairment in children a review of available data". *Ophthalmic Epidemiology* 6 (1999): 73-82.

14. Yemane B., *et al.* "Prevalence and causes of blindness and Low Vision in Ethiopia". *The Ethiopian Journal of Health Development* 21.3 (2007): 204-210.

15. Mehari ZA and Yimer AW. "Prevalence of refractive error among school children in rural central Ethiopia". *Clinical and Experimental Optometry* 96 (2013): 65-69.

16. Kawuma M and Mayeku R. "A survey of the prevalence of refractive errors among children in lower primary schools in Kampala district". *African Health Sciences* 2 (2002): 69-72.

17. Mehari ZA and Yimer AW. "Prevalence of refractive error among school children in rural central Ethiopia". *Clinical and Experimental Optometry* 96 (2013): 65-69.

18. Jafer Kedir and Abonesh Girma. "Prevalence of refractive error and visual impairment among rural school-age children of Goro district, Gurage zone, Ethiopia". *Ethiopian Journal of Health Sciences* 24 (2014): 353-358.

19. Assefa Wolde Yared., *et al.* "Prevalence of Refractive Errors Among School Children in Gondar Town, Northwest Ethiopia (2010).

20. Robert Wojciechowski and Nathan Congdon. "Heritability of Refractive Error and Familial Aggregation of Myopia in an Elderly American Population". *Investigative Ophthalmology and Visual Science* 46.5 (2005): 1588-1592.

21. Lyhne N., *et al.* "The importance of genes and environment for ocular refraction and its determiners: a population based study among 20-45 year old twins". *British Journal of Ophthalmology* 85 (2001): 1470-1476.

22. YoungTL., *et al.* "A second locus for familial high myopia maps to chromosome 12q". *American Journal of Human Genetics* 5 (1998): 1419-1424.

23. Kazuhiro H. Ophthalmology "Kyoto Japan: XXIII Cong. Refractive errors among Japanese school children 25 (1978): 1207-1211.

24. Lin Z., *et al*. "Generational difference of refractive error and risk factors in the Handan Offspring Myopia Study 55.9 (2014): 5711-5717.

25. BCSC Louis B., *et al.* "Basic and Clinical Science Course, optics of human eye, 2014- 2015 , section 3 83-89.

26. Hong RZ., *et al*. "Near-work activity and myopia in rural and urban schoolchildren in China". *Journal of Pediatric Ophthalmology and Strabismus* 38.3 (2001): 149-155.

27. Khader YS., *et al*. "Prevalence and risk indicators of myopia among schoolchildren in Amman, Jordan". *Eastern Mediterranean Health Journal* 12.3-4 (2006): 434-439.

Volume 12 Issue 12 December 2021