PREVALENCE OF REFRACTIVE ERRORS IN SCHOOLCHILDREN IN ROMANIA

Luminita Turcin[1], Afilon Jompan[2]

Abstract

The main aim of this study is to establish the refractive errors prevalence in rural and urban schoolchildren from Arad county.

Materials and Methods: We have examined 1121 pupils aged 6 to 11 years enrolled in elementary classes of 5 schools from Arad rural and urban environments during January - March 2012. We have investigated the following parameters: age, sex, objective refraction, visual acuity, family income. Refraction was measured with Potec 5000 autorefractokeratometer under cycloplegia which was obtained with cyclopentolate 4 times in one hour. Myopia was defined as refractive errors of at least -1.0 SD, hyperopia +1,5 SD and astigmatism 1.0 CD.

Results and discussions: Out of the total of 1121 children, 612 were in rural and 509 in urban environment. In rural environment we found 427 were emmetropic and 185 were found with refractive errors. There were 31 cases of myopia, 65 of hypermetropia and 89 cases of astigmatism. We found 12 new myopia cases, 23 new hyperopia cases and 48 new astigmatism cases.

In urban environment, 379 were emmetropic and 130 were found with refractive errors. There were 17 cases of myopia, 43 of hypermetropia and 70 cases of astigmatism. Fifty children were newly discovered with ophthalmic refractive pathology and 33 didn't wear optical correction although they knew about their condition.

Conclusion: The most prevalent ophthalmic pathology in Arad rural and urban schoolchildren is astigmatism, followed by hyperopia and myopia. In rural environment astigmatism is more prevalent in girls and hyperopia is more prevalent in boys. Family income is another important risk factor in which correlates especially with the neglected ophthalmic refractive conditions. Elementary schoolchildren are a high risk group for developing refractive errors.

Key words: refractive errors, children, amblyopia, myopia, hyperopia, astigmatism

Introduction

Visual impairment of schoolchildren is one of the most common and addressable health problems. It is also the second leading cause of treatable blindness (1). Visual impairment is mainly cause by refractive errors like myopia, hypermetropia and astigmatism. Most of the children with uncorrected refractive errors are asymptomatic (or present mild symptoms like: frequent eye scratching, conjuctival congestion, epiphora, etc) and hence screening for myopia, hypermetropia and astigmatism helps in early detection and timely interventions. In countries with high attendance schools (like Romania), integration of vision screening within screening for other health issues is recommended. (2) Differences in the availability of eye care services (preferably conducted by eye specialist) and even the magnitude of refractive errors between rural and urban schoolchildren are not considered. (3) These study will discuss rural and urban ophthalmic pathology in preschool- and schoolchildren, the differences between the two environments, risk factors and possible consequences.

In a different study, Bucsa D. and collaborators concluded than the most common disorders in preschool- and schoolchildren are refractive errors. (4) There for early detection and consequence prevention are imperative.

Reliable data on prevalence and distribution of refractive errors from population-based surveys are needed to plan cost-effective programs devoted to the reduction of visual impairment and blindness.

Undiscovered and untreated refractive errors are an important cause of low visual acuity or amblyopia. Defining how visual impairment affects health and social outcomes is complex. Is the person more affected by deficits in distance visual acuity, in near visual acuity, or in the simultaneous use of both eyes? We found little recent data in the roumanian literature regarding the prevalence of myopia, hypermetropia and astigmatism at schoolchildren in Romania. We found no comparative study between urban and rural environment regarding prevalence of those refractive errors. Therefore, our objective is to determine the prevalence of this pathology in children from both rural and urban environment and to identify ways we can improve ophthalmic childcare. We must underline the importance of the screening of refractive errors because of the negative consequences that result from the early misdiagnose of these health problems. When visual impairment is present, there may be further effects on overall health, self-perception, educational attainment, job choices, and a number of other social factors. (14)

Amblyopia (also known as lazy eye) and its risk factors, is a decrease in visual acuity resulting from abnormal visual development in children. Due to its baneful consequences amblyopia is a major public health problem. Amblyopia is the most common cause of monocular or in some cases binocular vision loss in infants and young adults (7).

[1] "Vasile Goldis" University, Arad, PhD student
[2] "Vasile Goldis" University, Arad
E-mail: danbugari@yahoo.com, afilonjopan@yahoo.com

Amblyopia affects approximately 2-4% of the population (8). Most cases are associated with eye misalignment, usually esotropia in infancy or early childhood (9-10). Anisometropia is the difference in refractive error between the two eyes. It is associated with amblyopia. Anisometropia or a combination of strabismus and anisometropia are causally associated with amblyopia. In children under 7 years, amblyopia was associated with strabismus in 38% of cases, with anisometropia in 37% of cases and with both strabismus and anisometropia in 24% of cases (11). Correction of refractive errors is the first step in treating amplyopia. Correction alone has been shown to significantly reduce amblyopia. Occlusion is another important part of amplyopia treatment. Less frequent occlusion can be just as effective as more extensive occlusion. (11)

In the present work, prevalence and pattern of refractive errors (myopia, hyperopia, astigmatism) among school children in Arad has been studied for planning appropriate eye care programs to reduce the burden of visual impairment among younger population in this area. An important component of general medical care for people with visual impairment is the burden that they have in terms of quality of life.

Materials and methods

The study was conducted between September 2011 and March 2012. Verbal consents of school director, teachers and parents were obtained for screening the children. The research protocol adhered to the provisions of the Declaration of Helsinki for research involving human beings.

Target group size was calculated by the means of Kish and Leslie's formula for an expected prevalence of 30% with confidence limit of 5% and confidence level 99.99%.

We have examined 1121 pupils aged 6 to 11 years enrolled in elementary classes of 5 schools in Arad county rural environment and 5 schools from Arad city. There was no acute pathology that would have influenced refraction. The distant vision of a child was tested utilizing Snellen's Illiterate 'E' chart. The visual acuity was tested with the chart at 6 meters. If uncorrected vision was <0.6 in either eye, the child was declared to have defective vision. A cover-uncover test was then performed to confirm the diagnosis of strabismus. If eyes moved after removal of the cover, the child was considered to have a "phoria"; and if the degree of deviation did not change on cover and uncover, the child was considered to have a "tropia" [> 5 degree / 10Δ diopter (D)]. The eye movements were tested in 6 cardinal directions to rule out paralytic or restrictive strabismus. Anterior segment was examined with flashlight to detect cataract; congenital anomalies like anophthalmos, microphthalmos, large corneas; and evidence of previous eye surgery. Objective refraction was measured with Potec 5000 autorefractokeratometer under cycloplegia which was obtained with cyclopentolate 1% 4 times in 1 hour. This procedure was applied to all children, regardless of visual acuity. Family member income was voluntary stated by one parent.

Statistical analysis was conducted with Epi Info 7.

Emmetropia was defined as a spherical equivalent between -1.00 and +1.00. Myopia was considered when the measured objective refraction was more than or equal to –1.0 spherical equivalent diopters in one or both eyes. Hyperopia was considered when the measured objective refraction was greater than +1.50 spherical equivalent diopters in one or both eyes provided no eye was myopic. Astigmatism was considered to be visually significant if ≥1.00 D. Results are presented in tables and charts below.

All children with uncorrected refractive error were given low cost spectacles . Children with eye diseases were further examined and managed at the base clinic free of charge. The study results were shared with the scientific fraternity and policies for improving eye care of children were proposed.

		A. Rural Environment			
Class	No. pupils	Total refractive errors	Myopia	Hyperopia	Astigmatism
I.	147	38	9	12	17
II.	124	44	5	15	24
III.	168	47	10	18	19
IV.	173	56	7	20	29
Total	**612**	**185**	**31**	**65**	**89**
		B.Urban Environment			
Class	No. pupils	Total refractive errors	Myopia	Hyperopia	Astigmatism
I.	139	32	5	9	18
II.	149	40	5	12	23
III.	112	29	3	10	16
IV.	109	29	4	12	13
Total	**509**	**130**	**17**	**43**	**70**

Table 1. Number of children and distribution of refractive errors over classes.

Results

We found the following results: out of the total of 1121 children, 612 (54.59%) were in rural and 509 (45.41%) in urban environment

In the rural environment we found 427 (69.77%) were emmetropic and 185 (30.23%) were found with refractive errors (ammetropic). There were 31 (5.06%) cases of myopia, 65 (10.62%) of hypermetropia and 89 (14.54%) cases of astigmatism. This means that 30.23% of children from rural environment included in the study have ophthalmic refractive pathology. Results are shown in Table 1

Out of the total of 509 children examined from urban environment, 379 (74.46%) were emmetropic and 130 (25.54%) were found with refractive errors (ammetropic). There were 17 (3.34%) cases of myopia, 43 (8.45%) of hypermetropia and 70 (13.75%) cases of astigmatism.

We didn't found any statistical significant difference in the prevalence of total number of refractive errors or in any specific error.

In rural environment we examined 289 (47.22%) boys and 323 (52.78%) girls. We discovered 17 (54.83%) cases of boys and 14 (45.17%) cases of girls with myopia. There is no statistically significant difference between sexes in myopia. We discovered 41 (63.07%) cases of boys and 24 (36.93%) cases of girls with hyperopia. We discovered 29 (32.25%) cases of boys and 60 (67.75%) cases of girls with astigmatism. Prevalence of astigmatism was higher in girls (67.75%) than boys (32.25%) [p<0.00001], while hypermetropia was more prevalent in boys (63.07%) than in girls (36.93%) [p<0.005].

A. Rural Environment

	Pupils	Myopia	Hyperopia	Astigmatism	Refractive errors
Male	289	17	41	29	87
Female	323	14	24	60	98
Total	612	31	65	89	185

B. Urban Environment

	Pupils	Myopia	Hyperopia	Astigmatism	Refractive errors
Males	230	7	28	25	60
Females	279	10	15	45	70
Total	509	17	43	70	130

Table 2. Distribution of refractive errors over sexes.

A. Rural Environment:

	No. cases	Procent (%	Myopia	Hyperopia	Astigmatism
No of pupils	612	100			
Total refractive errors	185	30.23	31	65	89
Newly discovered refractive errors	83	13.56	12	23	48
known and uncorected refractive er	71	11.6	11	19	41

B. Urban Environment

	No. cases	Procent (%	Myopia	Hyperopia	Astigmatism
No of pupils	509	100			
Total refractive errors	130	25.54	17	43	70
Newly discovered refractive errors	50	9.82	5	18	27
known and uncorected refractive er	33	6.48	4	14	15

Table 3. Newly and neglected refractive errors distribution.

A. Rural Environment

Age	No pupils	%	Myopia cases	%	Hyperopia cases	%	Astigmasm cases	%
6	45	7.35	4	12.9	5	7.69	8	8.99
7	115	18.79	5	16.13	7	10.77	15	16.85
8	97	15.85	5	16.13	11	16.92	19	21.35
9	120	19.61	4	12.9	12	18.46	11	12.36
10	112	18.3	6	19.35	14	21.54	17	19.1
11	123	20.1	7	22.58	16	24.62	19	21.35
Total	612	100	31	100	65	100	89	100

B. Urban Environment

Age	No pupils	%	Myopia cases	%	Hyperopia cases	%	Astigmasm cases	%
6	23	4.52	2	11.76	3	6.98	5	7.14
7	111	21.81	3	17.65	7	16.28	13	18.57
8	87	17.09	4	23.53	11	25.58	17	24.29
9	99	19.45	4	23.53	8	18.6	9	12.86
10	109	21.41	2	11.76	6	13.95	11	15.71
11	80	15.72	2	11.76	8	18.6	15	21.43
Total	509	100	17	100	43	100	70	100

Table 4. Age groups distribution of refractive errors.

A. Rural Environment

Income/FM	No. of pupils	Procent (%)	Refractive Errors	Procent (%)	Neglected	Procent (%)
<700	179	29.25	45	24.32	40	56.34
700-1500	285	46.57	93	50.27	26	36.62
1500-3500	103	16.83	34	18.38	5	7.04
>3500	45	7.35	13	7.03	0	0

B. Urban Environment

Income/FM	No. of pupils	Procent (%)	Refractive Errors	Procent (%)	Neglected	Procent (%)
<700	62	12.18	38	29.23	18	54.55
700-1500	155	30.45	50	38.46	11	33.33
1500-3500	190	37.33	30	23.08	3	9.09
>3500	102	20.04	12	9.23	1	3.03

Table 5. Income / family member relations with refractive errors.

In urban environment in this study we examined 230 (45.18%) boys and 279 (54.82%) girls. We discovered 7 (41.17%) cases of boys and 10 (58.83%) cases of girls with myopia. There is no statistically significant difference between sexes in myopia. We discovered 28 (65.11%) cases of boys and 15 (34.89%) cases of girls with hyperopia. We found 25 (35.71%) cases of boys and 45 (64.29%) cases of girls with astigmatism. Prevalence of astigmatism was higher in girls (64.29%) than in boys (35.71%) [p<0.001], while hypermetropia was more prevalent in boys (65.11%) than in girls (34.89%) [p<0.005].

Comparing the pupils from the to target groups (rural/urban) we didn't found any statistical significant variation in the prevalence of myopia, hyperopia or astigmatism based on sexes. Data are displayed in Table 2.

Out of the 612 children from rural environment examined, 185 (30.23%) were found with refractive errors. Eighty-three (44.86%) children were newly discovered with ophthalmic refractive pathology and 71 (38.37%) didn't wear optical correction although they knew about their condition. Hence, 154 pupils overall didn't wear optical correction for their ophthalmic pathology, because either they didn't know about it or they were not compliant with the treatment.

In the urban environment out of the total number of 509 children examined, 130 (25.54%) were found with refractive errors. Fifty (38.46%) children were newly discovered with ophthalmic refractive pathology and 33 (25.38%) didn't wear optical correction although they knew about their condition. Hence 83 pupils overall didn't wear optical correction for their ophthalmic pathology, because either they didn't know about it or they were not compliant with the treatment.

In rural environment 31 (5.06%) children examined wore optical correction at the time the study was conducted. Forty-seven (9.23%) of the 509 children examined form urban environment wore optical correction at the time the study was conducted. There is a statistical significant difference in the prevalence of optical correction. [p<0.006].

In rural children we found 12 (6.48%) new myopia cases, 23 (12.43%) new hyperopia cases and 48 (25.94%) new astigmatism cases. The number of new cases, expressed as percentage of total number of children examined, was as follows,: 1.96% myopia cases, 3.75% hyperopia cases and 7.48% astigmatism cases.

In rural children we found 11 (5.94%) known and neglected myopia cases, 19 (10.27%) known and neglected hyperopia cases and 41 (22.16%) known and neglected astigmatism cases. The number of known and neglected cases, expressed as percentage of total number of children examined, was: 1.89% myopia cases, 3.10% hyperopia cases and 6.70% astigmatism cases.

In urban children we found 5 (3.84%) new myopia cases, 18 (13.86%) new hyperopia cases and 27 (20.76%) new astigmatism cases. The number of new cases, expressed as percentage of total number of children examined, was as follows: 0.98% myopia cases, 3.53% hyperopia cases and 5.39% astigmatism cases.

In urban children we found 4 (3.07%) known and neglected myopia cases, 14 (10.76%) known and neglected hyperopia cases and 15 (11.53%) known and neglected astigmatism cases. The number of known, yet neglected cases, expressed as percentage of total number of children examined, was: 0.78% myopia cases, 2.75% hyperopia cases and 2.94% astigmatism cases. Forty-seven (9.23%) from the 509 children examined wore optical correction at the time the study was conducted. Results are shown in Table 3.

Considering each type of refractive errors in rural environment we have 38.70% new myopia cases, 35.48% known and neglected myopia cases, 35.38% new hyperopia cases, 29.23% known and neglected hyperopia cases 53.93% new astigmatism cases and 46.07% known and neglected astigmatism cases. In urban environment we have 21.41% new myopia cases, 23.52% known and neglected myopia cases, 41.86% new hyperopia cases, 32.55% known and neglected hyperopia cases 38.54% new astigmatism cases and 21.42% known and neglected astigmatism cases.

In rural environment 74.19% of the children with myopia, 64.61% of the children with hyperopia and 100% of the children with astigmatism didn't wear optical correction at the time of examination because either they didn't know about their pathology or they have shown low compliance with the treatment. Related to the total number of children from rural environment examined, we found 3.76% untreated myopia cases, 6.86% untreated hypermetropia cases and 14.54% untreated astigmatism cases. Statistically significant differences can be seen between myopic and astigmatic cases (3.76% and 14.54% p<0.00001) and between hyperopic and astigmatism cases (6.86% and 14.54% p<0.00001). There was no statistically significant difference between hypermetropic and myopic cases.

In urban environment 52.94% of the children with myopia, 74.41% of the children with hyperopia and 60% of the children with astigmatism didn't wear optical correction at the time of examination because either they didn't know about their pathology or they have shown low compliance with the treatment. Related to the total number of children from urban environment examined, we found 1.77% untreated myopia cases, 6.17% untreated hypermetropia cases and 8.25% untreated astigmatism cases. Statistically significant differences can be seen between myopic and hypermetropic cases (1.77% and 6.17% p<0.001) and between myopic and astigmatism cases (1.77% and 8.25% p<0.0001). There was no statistically significant difference between hypermetropic and astigmatism cases.

Comparing the two environments we found higher prevalence of known and uncorrected refractive errors in rural environment (71 cases) than urban environment (33 cases). [p<0.005]. Similar, we found a higher prevalence of known and uncorrected astigmatism in rural environment (41 cases) than urban environment (15 cases). [p<0.01].

The prevalence of myopia, hyperopia and astigmatism over age groups in the two environments studied are shown in Table 4. There was no statistically significant difference in the prevalence evolution over these age groups in neither of the studied refractive pathologies. There is no difference between the 2 environments either.

Another interesting aspect was the influence of family income over the prevalence and treatment of those refractive errors. Findings are presented in table 5.

In rural environment we found 179 pupils who lived in families with less the 700 ron/family member from which 45 had refractive errors and 40 neglected them. We found 285 pupils who lived in families with income between 700 and 1500 ron/family member from which 93 had refractive errors and 26 neglected them. We found 103 pupils who lived in families with income between 1500 and 3500 ron/family member from which 34 had refractive errors and 5 neglected them. We found 45 pupils who lived in families with income over 3500 ron/family member from which 13 had refractive errors and none neglected.

In urban environment we found 62 pupils who lived in families with less the 700 ron/family member from which 38 had refractive errors and 18 neglected them. We found 155 pupils who lived in families with income between 700 and 1500 ron/family member from which 50 had refractive errors and 11 neglected them. We found 190 pupils who lived in families with income between 1500 and 3500 ron/family member from which 30 had refractive errors and 3 neglected them. We found 102 pupils who lived in families with income over 3500 ron/family member from which 12 had refractive errors and one neglected.

In both environments, referring to the neglected refractive errors there is a statistical significant difference in the <700 and 700-1500 groups over the 1500-3500 and >3500 groups. In the rural environment there is a statistical significant difference in the neglected refractive errors between the <700 and 1500-3500 groups [p<0.00003] and 700-1500 and >3500 groups [p<0.01]. In the urban environment there is a statistical significant difference in the

neglected refractive errors between the <700 and 1500-3500 groups [p<0.0000001] and 700-1500 and >3500 groups [p<0.01]. Comparing the same level off income in the two environments we found no statistical significant differences in the neglected refractive errors.

Discussions

In a study on rural India schoolchildren, Dandona R. (13) reported the prevalence of myopia (-0.50SD) of 4.1% (similar to our study 4.28%), of hyperopia (+2.0SD) 0.78% and of astigmatism (0.75CD) of 2.8%. There are many papers on childhood refractive error in the international literature, reporting a broad, worldwide variation in the prevalence of myopia and hyperopia. Substantial differences in methods, definitions, and demographics are an important source of results variation. (2)

In 2003, Budau M. and collaborators conducted a screening of refractive errors of children investigated at "Luis Turcanu" Hospital's Ambulatory. They concluded that: out of the 646 children, 407--63% (CI95 = 59.1-66.7) had refraction errors, out of which 1.5% (CI95 = 0.8-2.9) were myopic, whereas 49.8% (CI95 = 45.9-53.8) were hyperopic. Astigmatism was found in 11.8% (CI95 = 9.4-14.6), and the mean age was 10.7 years (6). Compared to their study we found higher prevalence of myopia (4.28% in our study and 1.5% in the cited study [p<0.0001]). Differences in prevalence are found in astigmatism cases, which we found to be most frequent, while in the above mentioned study hyperopia had the highest prevalence. We believe the differences arise from the different definitions of the studied pathology. Our target group is from rural environment only. In the cited study there was no differentiation between the two environments in which regards the target group. Patients who went to "Luis Turcanu" Hospital's Ambulatory already had some symptoms and possibly a current disease. This could be a good explanation for the high percentage of refractive errors found (63%). Their target group doesn't have a classification of the child's developing environment. Our study group is form exclusively of schoolchildren aged 6 to 11 from rural areas of Arad County.

In a study, Bucsa D. and collaborators concluded that the most common disorders in preschool- and schoolchildren are refractive errors. (4) We found that 71.91% of children from the study were emmetropic and 28.09% ammetropic. This could mean that about one quarter of elementary schoolchildren have refractive errors. The quality of life can be altered in those untreated children. Rahi et al found that those with impaired vision, even if the impairment was unilateral, were more likely to have an unskilled manual labor job and were more likely to be unable to work because of permanent illnesses. These odds were increased with worsening distance acuity. Visually impaired people were not found to be more likely to have a greater number of injuries at work or at home or injuries related to sports than were people with normal sight. (15)

In 2001, Hendrickson K, Bleything W. conducted a screening of Romanian children and adults. They found the following data: 45% of the children were emmetropic, 27% were myopic, and 28% were hyperopic. When compared with other nations, the prevalence of myopia was higher in the Romanian children. With-the-rule astigmatism had the highest occurrence when compared to other axis orientations, yet the overall occurrence of astigmatism was less than that found in other nations for both children and adults. Incidence of astigmatism was lower compared to other nations in both children and adults. The prevalence of strabismus and other ocular diseases was lower in the Romanian children as compared to other nations. (5) Refractive errors were more likely to have a manual (versus non-manual) occupation and to be separated, divorced or widowed, and less likely to be in social or professional organizations. There is also some evidence that they are more likely to express concern, embarrassment and frustration about their eyesight and worry about coping with life.

Rahi et al reported the use of the Vision-Related Quality of Life Core Measure 1 and these investigators found that impairment of vision-related quality of life was strongly correlated with impairments in visual acuity at both distance and near and with impaired stereopsis. Impaired vision-related quality of life was strongly associated with inability to work and with not currently being married. (15)

Conclusions

The most prevalent ophthalmic pathology in Arad rural and urban schoolchildren is astigmatism, followed by hyperopia and myopia. In rural environment astigmatism is more prevalent in girls and hyperopia is more prevalent in boys. There is no statistically significant difference in the prevalence of myopia cases in the two sexes.

Comparing the two environments we didn't found any statistical significant difference in the prevalence of total number of refractive errors or in any specific error.

In urban environment the prevalence of optical correction was statistically significant higher than in rural environment. We didn't find any variation of prevalence between age groups from 6 to 11 in any of the studied refractive pathology.

The most prevalent newly discovered ophthalmic pathology in rural schoolchildren is astigmatism, followed by hypermetropia and myopia.

Elementary schoolchildren are a high risk group for developing refractive errors. From those astigmatism is the main risk factor of developing amblyopia, followed by hyperopia and myopia.

The most prevalent known and uncorrected (neglected, poor treatment compliance) ophthalmic pathology in rural schoolchildren is astigmatism, followed by hypermetropia and myopia. Basically, no child with astigmatism had any optical correction.

We believe that the newly discovered refractive errors can be addressed by screenings like this one. It is a good way to discover and treat children ophthalmic pathology and prevent amblyopia. Visual acuity screenings are needed to discover refractive pathology in children. The screening of school and preschool children should be carried out

periodically. Most children are unaware of their refractive errors.

Family income is another important risk factor in which correlates especially with the neglected ophthalmic refractive conditions. Interesting is that at the same level of income there is no difference between the two environments.

References

1. Dandona R, Dandona L. Refractive error blindness. Bull World Health Organ. 2001;79:237–243.
2. World Health Organization. Elimination of avoidable visual disability due to refractive error Report of an informal planning meeting. pp. 6–10. WHO/PBL/00.79.
3. Amruta S. Padhye, Rajiv Khandekar,1 Sheetal Dharmadhikari, Kuldeep Dole, Parikshit Gogate, and Madan Deshpande, Prevalence of Uncorrected Refractive Error and Other Eye Problems Among Urban and Rural School Children, Middle East Afr J Ophthalmol. 2009 Apr-Jun; 16(2): 69–74
4. Bucşă D, Gavăt V, Albu A. Aspects of child and youth health revealed by medical check-up in Botosani County, Romania]. Rev Med Chir Soc Med Nat Iasi. 2011 Oct-Dec;115(4):1225-30.
5. Hendrickson K, Bleything W. , The visual profile of Romanian children and adults assessed through vision screenings. Pacific University, College of Optometry, Forest Grove, Oregon, USA. hendricksonk@hotmail.com. Optometry. 2001 Jun;72(6):388-96.
6. Budău M,Gamaniuc E,Moise C, Korbuly B. Study of refractive changes in Timiş county.Oftalmologia. 2003;58(3):64-9
7. Doshi NR, and Rodriguez MLF. Amblyopia. Am Fam Physician 2007;75:361-7.
8. Chang CH, Tsai RK, Sheu MM. Screening amblyopia of preschool children with uncorrected vision and stereopsis tests in Eastern Taiwan. Eye 2007;21:1482-8.
9. Woodruff G, Hiscox F, Thompson JR, Smith LK. Factors affecting the outcome of children treated for amblyopia. Eye. 1994;8:627-631
10. The Pediatric Eye Disease Investigator Group. The Clinical Profile of Moderate Amblyopia in Children Younger Than 7 Years. Arch Ophthalmol. 2002;120: 281-287.
11. Shaw DE, Fielder AR, Minshull C, Rosenthal AR. Amblyopia: factors influencing age of presentation. Lancet 1988;2:207-209.
12. Prevalence of Refractive Errors in Primary School Children [7-15 Years] of Qazvin City, European Journal of Scientific Research, ISSN 1450-216X Vol.28 No.2 (2009), pp.174-185
13. Dandona R, Dandona L, Srinivas M, Sahare P, Narsaiah S, Muñoz SR, Pokharel GP, Ellwein LB. Refractive error in children in a rural population in India. Invest Ophthalmol Vis Sci. 2002 Mar;43(3):615-22.
14. Stefanie Davidson, MD, Graham E. Quinn, MD, The Impact of Pediatric Vision Disorders in Adulthood,PEDIATRICS Vol. 127,No. 2. February 1, 2011 pp.334-339 (doi: 10.1542/peds.2010-1911)
15. Rahi JS, Tadić V, Keeley S, Lewando-Hundt G; Capturing children and young people's perspectives to identify the content for a novel vision-related quality of life instrument Vision-related Quality of Life Group., Ophthalmology. 2011 May;118(5):819-24. Epub 2010 Dec 3.
16. Rahi JS, Peckham CS, Cumberland PM. Visual impairment due to undiagnosed refractive error in working age adults in Britain. Br J Ophthalmol. 2008 Sep;92(9):1190-4.
17. Luminita Turcin, Afilon Jompan, Prevalence of refractice errors in schoolchildren in rural environment. Medicine in Evolution, vol XVIII nr. 3, 2012,
18. Luminita Turcin, Afilon Jompan, Prevalence of refractice errors in schoolchildren in urban environment, Physiology, vol 23 nr. 3 (75), 2012.

Correspondence to:

Luminita Turcin
"Vasile Goldis" University, Arad"
Bulevardul Revoluţiei 94 Arad
E-mail: crisan.danbugari@yahoo.com