REFRACTORY ANOMALIES ON PRESCHOOL CHILDREN IN STIP

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Abstract: Introduction: The refractive anomalies are the most common vision disorders that affect children. For pre-school children, amblypia and the amblyogenic risk factors, like strabismus and significant refractive errors are the most prevalent and most significant vision disorders. The early diagnosis of these disorders allows for an intervention at a time in which treatment and further development prevention are highly possible.
Patients and methods: In a period between January 15th and April 15th in 2016, within the screening program for vision disorders at pre-school children in Shtip, 890 children were examined during their stay at kinder garden. The screening was done with a 2WIN mobile binocular refractometer intended for detecting refractive errors, vision anomalies and measuring pupil parameters.
Purpose: The goal of this study is to determining the prevalence of vision disorders at pre-school children in Shtip, identifying, early diagnosis and treatment of the vision disorders and also determining the need and benefit of regular pre-school screening program for vision disorders.
Results: Abnormalities of the measured parameters are detected within 45.17% of the examined children. Refractive anomalies are detected within 13.37% of all children. 0.56% of all have hyperopia, 1.46% have myopia and 12.13% have astigmatism. Anisometropia >1D was detected within 2.47%, while gaze deviation >4.6° was detected within 34.46%.
Conclusion: The screening of pre-school children allowed for an early diagnosis and treatment of refractive errors and ambliogenic factors. With early treatment, amblyopia can be prevented, the life quality can be improved and better academic achievments can be made.
Keywords: epidemiology, Shtip, pre-school age, refractive anomalies, screening

1. INTRODUCTION

Refractory errors occur in a significant proportion of the world population, affecting both sexes and all ages. When it comes to affected children, refractive error and visual disturbances have a significant impact in terms of their education, future employment and social well-being throughout life. Children can not complain of symptoms associated with their eyes and not understand that they see no good, but with the active search and early detection of ocular abnormalities, ocular findings may indicate the presence and serious conditions (expl. Retinoblastoma) early detection these situations can save lives.

Although eye examinations in the neonatal period are important, they can not predict the occurrence of conditions which often occur after infancy as accommodative esotropija. By then they could develop additional vision problems, and children three years already beginning to acquire communication skills that could enable them to be examined by methods that are used for eye examination in adults. Therefore, eye exams/screenings are recommended before the age of three. An additional advantage of the eye examination in this age group is that it allows intervention in times when problems are highly susceptible to treatment.

Britain, Sweden, the Netherlands and some East European countries already have population-based eye screening programs for children. Assessment of visual acuity at the age of 4 years (preschool) is the most common. 2 In the UK, 74% to 80% of ortoptichkite departments provide some kind of preduchilipen eye screening, with most of skrininzite (88%) were implemented at the 3-4 year olds. In the US, it is estimated that 21% of children spend their preschool screening.[1]

In a study designed to assess the prevalence of refractory errors and associated visual disorders among school children in urban population in New Delhi, India (2002), it observed that: 81.7% of cases of visual impairment were

caused by refractory errors, amblyopia was represented by 4.4%, retinal disorders with 4.7% and other causes in 3.3% and unknown etiology in the remaining 5.9%.[4]
In addition to the need for preschool screening program testify and study visual disorders among 7-year-olds with and without previous eye screening (Sweden, 1978), which found that the risk of discovery of new significant visual impairment in prvooddelenchinja is 6 times greater for a child who has not been examined in his earlier years and the risk of detection ambliopichno child increased by more than 10 times.[16]
The lack of universal and age appropriate pre-screening program continues to contribute to unacceptable prevalence of permanent loss of vision disorders such as amblyopia, most of which are reversible if detected and treated early. [1]

In Republic of Macedonia, it has no policy or regular program of pre-school eye screening.
The purpose of this pilot study was to determine the prevalence of disturbances in the pediatric population of preschool age in Stip, identification and early diagnosis of children with visual impairment and determining the need for and benefits of introducing a regular preschool screening program for visual disorders.

2. TOPICS AND CHAPTERS

2.1. Visual acuity. A visual acuity measure of the smallest object which the person can recognize a certain distance of the eye. The measurement of visual acuity at far should be performed in all children as soon as possible before the age of 3 because of the importance of early detection of amblyopia (poor vision).[7]
General concepts:
Minimum visibile. The smallest amount of light energy that falls receptor and is able to cause excitation, known as minimum visibile (minimum of provenances) minimum vidnosta except the amount of light that enters the eye, depends on the natural sensitivity of the photoreceptors which it is not the same for all people.
Minimum separabile. Smallest prominent corner in which two objects can not be seen as separate, called minimum separation. Minimum separation depends on the number of receptors per unit area of the retina. In other words, it depends on the width of the photoreceptors which are not the same from one individual. Where they are densely arranged visual acuity will be better and will go under 6/6, which is taken as normal. Minimum Angle value is separable and is a factor in determining the visual acuity.
Minimum discriminatione. An opportunity of cone cells in the retina to detect the slightest difference in the intensity of light falling on them. Thus, it is tonal contrasts of the image formed on the retina. [5]
Visual acuity is tested separately for each eye. One eye is covered with a piece of paper or easy placement of the hand to the eye. The fingers should be patient because the eye can see through them. [7] From patient to recognize or read the figures on the blackboard on the wall before him, going from larger to smaller. The figures are in the form of letters, numbers, incomplete circles, the letter E facing in different directions, stickers for children itn.ovie figures in ophthalmology known as optotype (optotypi ad visum determinandum), and each piece is one optotype. Usually they are written on a blackboard and arranged by size.

Snellen's panel optotipi test of visual acuity was first introduced in ophthalmology, and today the most widely used. It font size ie lines that make up one of the boundaries of the letter is an angle of a minute (1 ') and the point at an angle of 5 minutes (5'), as viewed from a certain distance. It can best be understood if we take the letter E, and analyzed through optotipite of Snell. The Bukavu E has three black and two white feet feet. Each at an angle of 1 ', and the whole case will be the sum of five feet and then takes an angle of 5' when viewed from a certain distance. Thus, the letter E in the first row forms this angle at a distance of 60m; letter of the second line at a distance of 36m; letters from the third row at a distance of 24m; fourth of 18m; fifth of 12m etc.

With this grading the size of the letters determines the visual acuity according to the formula proposed from Snell, which reads: $V = d / D$, where d represents the distance from which the letters were read, and the distance D from which they should be read. For example, if the patient sees only the front row means that, its visual acuity was 6/60, which means that his eye at a distance of 6m sees what normal eye sees of 60m. Adequate proportions have Visual acuity above 6/60; 6/36; 6/24; 6/18; 6/12; 6/9; 6/6 is considered normal vision. Many people, especially among the young, have a better appearance than normal and it is noted as Visual acuity 6/5; or 6/4 or 6/3 even sharper. This ability of their macula to see more clearly than others due to the higher density of cones per unit area (smaller minimum separabile), compared to the minimum separable among people who normally see.

Snellen's boards with 7 or 10 lines are still used in ophthalmic institutions, the principle of distance of 6 m.

The celebration of visual acuity can be performed using the decimal system ranging from 0.1; through 0.2; 0.3; 0.4; 0.5; 0.6; 0.7; 0.8; 0.9 do 1.0. If the patient is seen in 1.0 that visual acuity is indicated as 1.20 (6/5); 1.5 (6/4) or 2.0 (6/3). The boards with a decimal mark, test symbols are arranged in 13 rows.

2.2. Light

Light is the visible part of the spectrum of electromagnetic radiation. Situated between ultraviolet and infrared rays with a wavelength of 400- 700 ηm. Light beam is a term used to describe the radius of the concentric waveforms. A group of parallel light rays narekula beam. Light beam on its way is subjected to refraction, diffraction, reflection and absorption of other phenomena typical of wave movements.

2.3. Refraction of the eye

2.3.1 General terms. The phenomena of changing the direction of stretching of light rays when transferred to another locality known as infringement or refraction. Light beam on its way is subjected to refraction, diffraction, reflection and absorption of other phenomena typical of wave movements. The notion of light refraction of the eye are referred all normal and abnormal violations when she goes through the eye media to reach the retina.

The speed of light in a vacuum is 3h108 m/s, and the index of refraction is N = 1. For air N = 1.00029. so in practice accepted that equals vacuum, water is N = 1.33. for glass N = 1.5 to 1.75, depending on the nature of the glass.

2.3.2. Refraction of light. When the light beam falling on a surface at a right angle, he is breached, although changing the wavelength, and thus speed. If the light beam falls at an angle of an environment that is homogeneous and has parallel surfaces, it will be broken and the input and output side but will not change the direction because the angle input and output are equal. Ophthalmic prisms used in ophthalmology is made of refractive material, a wedge shape with three sides, top and base. If we place the prism of the path of the rays converge to form an image, the image will be formed to the base of the prism, used in making optical prisms and string instruments. Prisms low power incorporated in glasses for glasses and contact lens.Prism's diopter (pD), as a separate concept in terms of diopter lens, a prism effect to turn the light beam by 1 cm length of 1m.

2.3.3. Plus and minus lenses. If you put together two prisms with bases in the center, we receive rallying or plus lens that light rays passing through it to converge and create a real focus behind the lens.

Pickup or plus lens used for the correction of hyperopia eye, because rays to him imaginary intersect behind the retina and lens plus they do focus on the retina. Scattered or minus lens used for correction of myopia because rays miotropic eye cut in front of the retina and minus lens will focus on the retina.

The strength of a breach of the lens is measured in diopter according to the focus pickup lens does when rays pass through it to the formula D = 1 / d, where D is the power in diopter, d is the distance in meters. In other words, a pickup lens has a strength of 1D if the rays focus at a distance of 1m.

2.3.4. Astigmatic lenses. Conversely spherical lens, which has the same refractive curvature and the same strength in all meridians, astigmatskata lens is made so that the two main meridians standing angle 90^o different curved and different breaks. Astigmatskite lenses are divided into cylinder and toric. The cylindrical lenses represent a snapshot of the cylinder, whereby one side is flat while the other follows the radius of the cylinder from which it was made. Toric lenses resemble a snapshot of the barrel, so to them and the two main meridians stand at an angle of 900. The astigmatic toric lenses, a larger proportion avoided monoculary aniseiconia characteristic of astigmatism a greater degree.

2.4. Refraction and growth

The child is usually born as prescient and mild degree of long-sightedness remains mostly during childhood. As the child grows, change, and axial length and refraction of the cornea and lens, but the relationship between the three main participants in the refraction usually evolve towards emetropy. During the growth of the child relationships are changing: antero axis increases, especially the cornea and the lens particularly aplaniraat and reduce refractive power. The reconciliation between the three main actors of refraction leads to emetropia. These relationships may be explained by the introduction of ultrasonic biometrics. It is assumed that there is a process for emetropisation which coordinates refractive factors such as axial length, radius of curvature the cornea, anterior chamber depth and lens refractive power.

2.4.1. Variations in refraction. Refraction of the eye in the first days and months is usually about 2D hyperopia. 7-year prevalent hyperopia, and before puberty and during adolescence prevalent myopia. There is no difference between the sexes, but there is a difference between races, people of the yellow race largely myopia. In terms of the amount and type of refractive anomaly when it is greater than + 4D greater than -6D, axial anomaly is (more or less antero axis).

2.4.2. Inheriting the refraction of the eye. Refraction abnormalities are inherited or created over a lifetime. The primary role heredity plays, and of less importance to environmental factors and lifestyle. Process emtropisation of eye occurs mainly to the 4th year of life. During that process, the eye should be trained equally well for viewing away and watch close. However, often run deviations and form a more eye capable of seeing far (hyperopia or longsightedness) and more trained eye for seeing close (myopia or shortsightedness).

2.4.3. Determination of refraction of the eye. Subjectively, routine determination of refraction is done with plates of paper with optotipi and a box of trial lenses. Subjective determination of refraction is often not enough to gain real insight into refractory error is especially true for children up to age 10. Objectively determining the refraction of the eye may be using ophthalmoscopy, refractometry (determines the total refraction of the eye, the magnitude of astigmatism and its axis) and the most reliable method retinoscopy, which is based on the principle of moving shadow that appears in the pupil of the eye, where it will focus a beam of light. [5]

2.4.4. Types of refraction of the eye: *Emmetropia.* The eye is emetropic if light rays that fall on the eye, do focus on the retina. Since parallel rays coming from infinity usually said that the eye sees indefinitely. In practice, it is considered that all the light rays coming from the distance of more than 6m, falling on the retina as parallel rays.
Ammetropia. The eye is ametropic if light rays focus on human retina, but the focus is generated before (myopia) or imaginary behind the retina (hyperopia).

2.5. Anomalies in the refraction

2.5.1. Myopia (short-sightedness, My) is a discrepancy in the refractive power and axial length of the eye, resulting in a convergence of parallel light rays at a focal point located in front of the retina. [6] Myopia or shortsightedness is refractive anomaly in which the patient sees far. [5] Approximately 25% of individuals 20-30 years have less than refractive -1D. [6] Myopia can be benign (school), which does not pass -6D. occurs in school time and cease to increase when growth stops, usually after puberty, and malignant myopia that occurs mainly in infancy, slower or quicker progress, especially in puberty and reaches the high value of -15 to -30D, and sometimes more.

New research showed that acomodation plays no role in the development of myopia. Myopia occurs and increases due to the unclear image created on the retina. Accordingly, the retina would be improved picture, stimulates factors responsible for hardened refraction and thus causes myopia or its growth. Accordingly, myopia and astigmatism, have you used to find on myopia not deteriorate. [5]

2.5.2. Hyperopia (Long-sightedness, Hy) means discrepancy between a refractory power and axial length of the eye in which parallel light rays converge at a focal point posterior to the retina. [6] The term hyperopia should mean that the patient looks good on given but poorly to close, which corresponds to the truth, because hyperopia see no good neither to close nor far. However, the patient has major difficulties when looking to close, because when looking at far used their accommodation if hyperopi not great visual acuity for far may be reversed. [5]

Approximately 20% of persons aged 20-30 years have refractive exceeding + 1D. More newborns have low hyperopia (infant hyperopia). It is reduced in the first years of life. In advanced age, refraction approaches myopia due to sclerosis of the nucleus of the lens. Hyperopia is a major cause of convergent strabismus and amblyopia in children. So, hyperopi should therefore be detected and promptly treated, especially if there is a difference in refraction between one and the other eye (anisometropia). And plain and high hyperopia can be corrected with surgery, but the results are much weaker than those achieved in myopia. [5]

2.5.3. Astigmatism (As) is derived from the Greek word *stigma (point*) and literally means the absence of a focal point. Disorder characterized with distortion of refractive media for which, parallel rays do not converge at one point. [6] It creates focus, because the curvature of the cornea and the lens in different meridians is different. The one meridian violates Nayak, the other, however. Always the largest curvature in relation to the smallest stand at an angle of 90°. The meridian which is most curved, vehemently breaks and meridian which is at least curved, however breaks. Those two are main meridians. Patients with astigmatism see everything distorted picture. Attempts to compensate for refractory error using of accommodation leading to symptoms such as a burning sensation in the eyes or headaches.

Astigmatism, usually exist from birth as inherited refractive anomaly, which may change throughout life. 42% of all people have astigmatism greater than or equal to 0,5D. at approximately 20%, the astigmatism is greater than 1D and requires optical correction. Ordinary astigmatism corrected by planocilindric lenses and complex astigmatism are prescribed combined lens consisting of spherical and cylindrical components.

2.5.4. Anisometropia is the difference in refractive power between the two eyes. The reason for the different development of both eyes is not known, but is primarily a congenital disease which shows a higher incidence as familial. Children are not aware that their appearance is abnormal. But there is a tendency to strabismus due binolularnata function, which can remain underdeveloped. Where the correction of anisometropia results in unacceptable anisoconia, patients will experience unpleasant visual sensations of double vision. Contact lenses, or in rare cases, surgical treatment is indicated. Patients who do not tolerate contact lenses, need incorporating intraocular lens. Correction unilateral afakija unilateral glasses is contraindicated because anisoconia resulting in

approximately 25%.[6] Unadjusted anisometropia can cause amblyopia. In hyperopia eyes and anisometropia less than 2 diopter, often leads to amblyopia. [5]

3. MATHERIALS AND METHODS

This is a descriptive and population-based study of a cross-section which includes 890 pre-school children from four kindergartens in Stip, Republic of Macedonia. It represents a pilot study, part of a screening program for visual disorders in pre-school children. In order to measure the prevalence of visual disorders in preschool children, there are pilot studies in several cities in the Republic of Macedonia.

The children were examined by an ophthalmologist during their stay in the nursery, presence and collaboration with their teachers / teachers. Children whose results deviate from the reference values are directed to additional eye exam with cycloplegic refraction in PHI "Pance Karagozov"-Stip. Screening is performed in 2WIN mobile binocular refractometer for detection of refractory errors, anomalies of the type and measuring pupillary parameters. Obtained and measurements of eye examination every child (Figure 1).

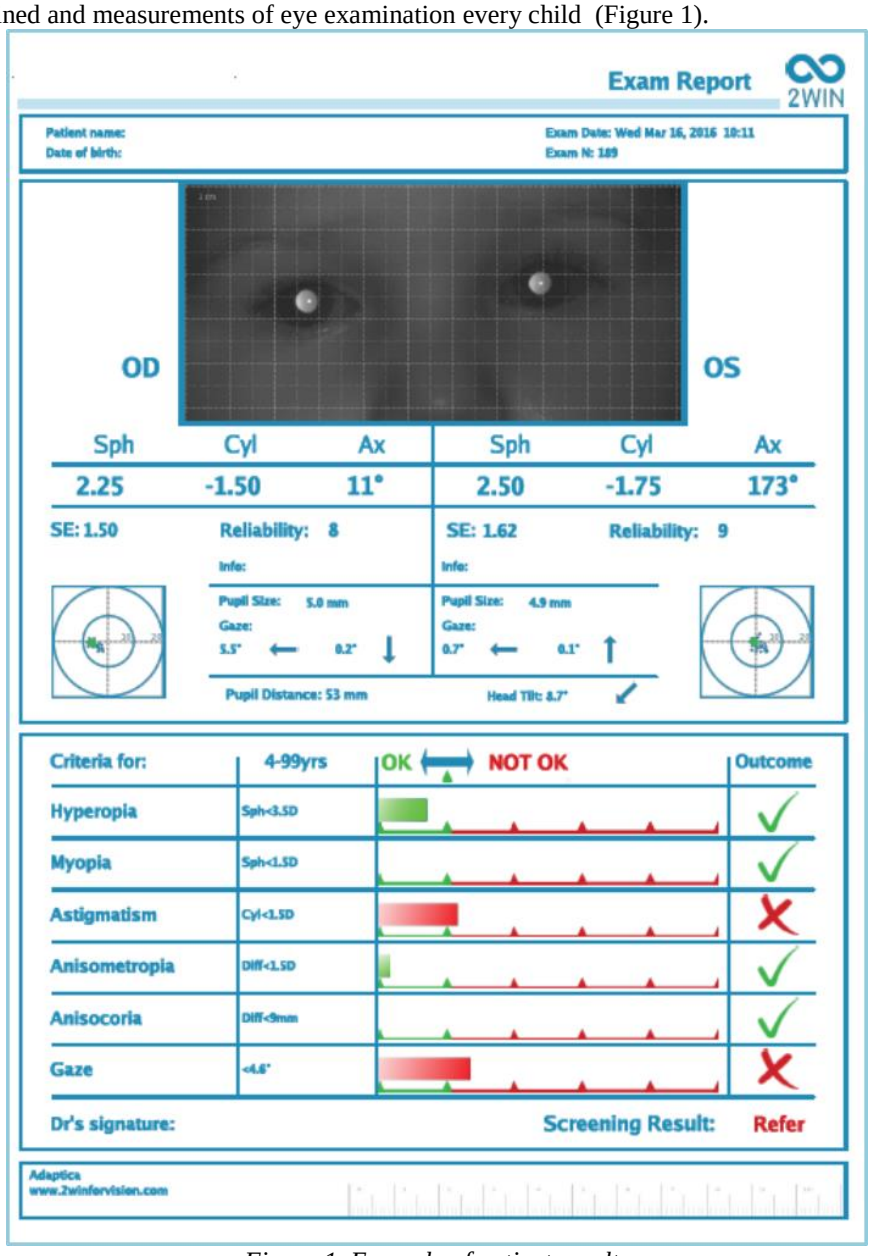

Figure 1. Example of patient results

The principle of measuring is a quirky photo-retinoscopy. Infrared (IR) are projected through the pupils of the patient to the retina. Depending refractory error, the reflected light is broken up and form a distinctive light pattern within the pupil. 2WIN camera measures the spherical and cylindrical power and axis through interpretation of reflected light beams. Reference values when interpreting the results of this study are shown in Table 1.

	Parameter	Values
1.	**Myopia**	Sph < -1.75 D
2.	**Hyperopia**	Sph >3.50 D
3.	**Astigmatism**	Cyl >1.50 D
4.	**Anisometropia**	Diff. >1.00 D
5.	**Anisocoria**	Diff. >1.00 mm
6.	**Angle**	>4.5^{o}

Table 1. Parameters and reference values.

4. RESULTS AND DISCUSSION

The study involved 890 children aged 2.5 to 6 years enrolled in kindergartens in Stip. Of these, 428 (48.09%) were male and 462 (51.91%) females.

Chart 1 shows the prevalence of visual impairment among participants. The analysis shows that 488 (54.83%) of respondents had results within the normal range. Deviation from the reference values of the tested parameters were observed in 402 (45.17%) of respondents. The large number of deviations due to the large number of individual performers with only deviation was in the sixth parameter or angle > 4.5^{o}.

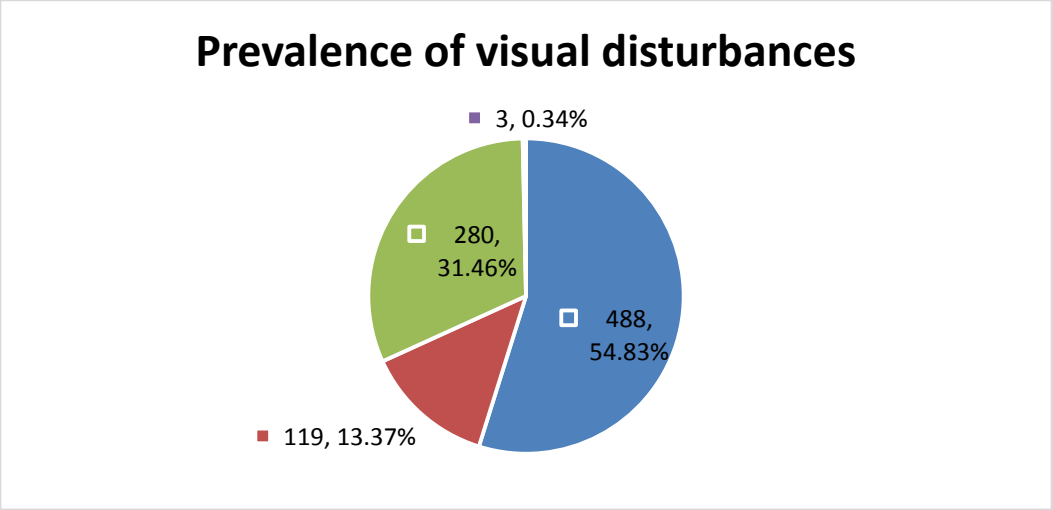

Chart 1. Prevalence of visual disorders: It is about 280 children or 31.46% of the respondents in that it is the presence of strabismus. Refractory errors were observed in 119 (13:37%) children without anisometropia refractory error (or limits) was observed in 3 (0.34%) children, while anisocoria not found in none of the children.

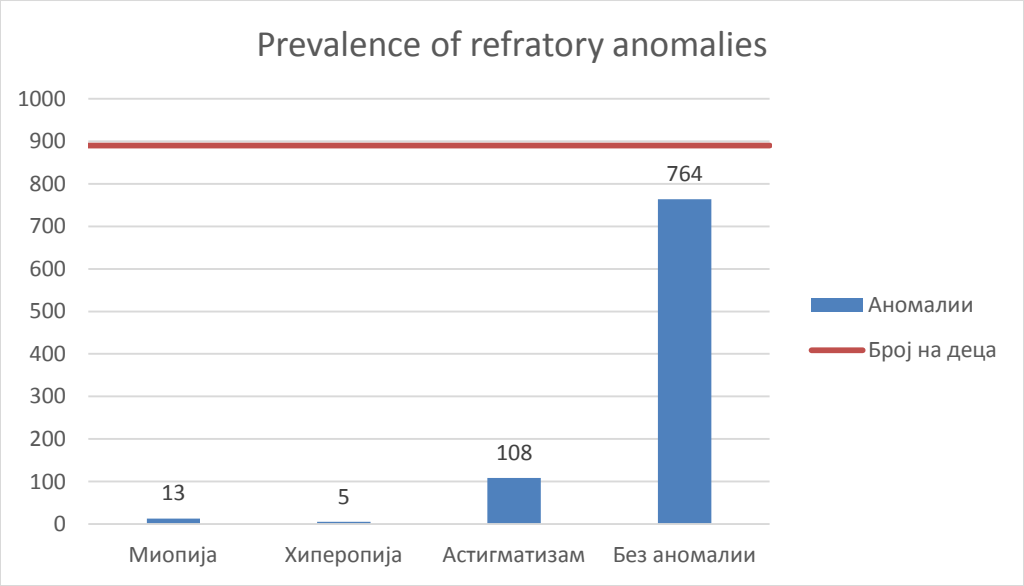

Chart 2. Prevalence of refractive anomalies: It may be noted that the most frequently refractory anomaly is astigmatism, present in 12.13% of the respondents, or 108 children. Myopia and hiperopijata are significantly underrepresented with 13 (1.46%) and 5 (0.56%) respondents respectively.

It may be noted that the prevalence of hyperopia was higher among children from China, Iran and India, than in children from C. Britain, the US, South African state, Nepal and Macedonia. It is interesting to note that the prevalence of hyperopia in our study is the lowest compared to other studies, which may be due to the established reference values when interpreting the results. Often, it is difficult to compare one study to another because of different designs and methods used in them. Table 2 shows the results of selected population-based study to compare the results.

Study	Country	Number of subjests	Age	Hyperopia (definition)	Hyperopia (prevalence) %	Miopia (definition)	Miopia (prevalence) %
Barnes et al. [8]	**Great Britain**	7600	7	>2.00 D	5.9	≤-1.00 D	1.1
Preslan et al. [9]	**USA**	680	4-7	>4.00 D	0.9	<-0.5 D	3.1
Naidoo et al. [10]	**South Africa**	458	6	≥2.00 D	3.8	≤-0.50 D	1.6
He et al. [11]	**China**	295	6	≥2.00 D	14.6	≤-0.50 D	2.7
Murthy et al. [4]	**India**	494	6	≥2.00 D	13.0	≤-0.50 D	5.9
Jamali et al. [13]	**Iran**	815	6	≥2.00 D	20.7	≤-0.50 D	1.7
Adhikari et al. [1]	**Nepal**	484	3-5	≥1.50 D	2.48	≤-1.00 D	24.17
This study	**Macedonia**	890	2,5-6	≥3,50 D	0,56	≤-0.75	1,46

Table 1. Prevalence of myopia and hyperopia in school-entry age children reported from selected population-based studies

The prevalence of myopia in our study is relatively low at 1.46%, close to the prevalence of myopia in studies of Iran, South Africa and B. Britain. The other said studies, the prevalence of myopia is a little higher, but significant discrepancy study from Nepal where it is 24.17%, which may be due to the fact that in the same study

77% of respondents are members of the yellow race (in different studies, we estimate that among them, there are more myopia prevalence) first although the prevalence of myopia in our study is among the lowest, it is possible for its overestimation, because it is not about ciklоplegichna refraction. With a view to a definitive assessment and treatment, children are sent to additional eye examination.

Study	Country	Number of subjects	Age	Astigmatism (definition)	Astigmatism (prevalence%)
Logan et al. [13]	**Great Britain**	352	6-7	≥1.00	10.3
Chisanga et al.[14]	**Zambia**	507	6-14	/	7.1
Naidoo et al.[10]	**South Africa**	4002	5-15	≥0.75	14.6
He et al. [11]	**China**	4322	5-15	≥0.75	42.7
Murty et al. [4]	**India**	5694	5-15	>0.75	14.6
Jamali et al. [12]	**Iran**	815	6	≥0.75	19.60
Adhikari et al. [1]	**Nepal**	484	3-5	≥1.00	5.17
This study	**Macedonia**	890	2.5-6	>1.50	12,13

Table 3. Prevalence of astigmatism according to selected population based studies

The prevalence of astigmatism in this study proved to be significantly higher than the prevalence of myopia and hyperopia. Compared with other selected studies (Table 4), the prevalence of astigmatism is close to the values obtained in studies C. Britanija13, Zambija[14], South Africa[10], Indija[4], and Nepal[1]. Moreover, although the value of prevalence does not differ significantly, both in Iran and China, it is a value that should not be overlooked. The number of children with hyperopia and myopia is small and accordingly does not constitute a representative sample. In terms of gender distribution of refractory anomalies in different studies obtained different results.
A study by "Naidoo et al.10" and "Giordiano et al.15" found no association myopia and hyperopi a sex while "He et al.11" and "Chisanga et al.14" myopia associated with females. In view of astigmatism in this study, as in "Naidoo et al.10" and "Chisanga et al.14" found no significant association of astigmatism with gender.

In contrast, other studies as "Murthy et al.4 and He et al.11", point of connection of astigmatism with the female. The gender distribution of hyperopia, myopia and astigmatism is shown in Table 4.

Gender	Refractory anomaly		
	Miopia	Hyperopia	Asthigmatism
Male	1 (20%)	6 (46.15%)	50 (46,30%)
Female	4 (80%)	7 (53.85%)	58 (53.70%)

Table 4. Gender distribution of refractive anomalies

In terms of anisometropia, the prevalence of children with difference in spherical equivalent > 1D was 2.47% (22), with one difference > 1.5D have 1.01% (9). A possible cause of refractive amblyopia, it is necessary for it to be timely and appropriate treatment in order to prevent deterioration and the occurrence of irreversible changes.
The biggest benefit of this study is precisely the ability to prevent the development of amblyopia in children and significantly improve their quality of life.

5. CONCLUSION

Results showed that a significant percentage of preschool children have refractory anomaly, with astigmatism clearly dominates in terms of prevalence. Undetected or untreated, refractory anomalies in the future could adversely affect educative progress of the child and undermine its potential for learning. The earlier a diagnosis, the better is the prognosis for the type and intervention. Children should not bear the burden of reduced visual acuity that affects the daily lives and learning. Important benefits of this study revealed anisometropia,

refractory anomalies, and the increased angle as an indicator of the possibility of developing strabismus. Their early detection leads to a timely and successful treatment that no child would be deprived of an excellent visual acuity.

According to the study results, we recommend regular screening program for visual disorders in preschool children to be incorporated into the health program of the Ministry of Health, in order to timely diagnosis and treatment of visual disorders.

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