Medical University - Varna "Prof. Dr. Paraskev Stoyanov"
Faculty of "Medicine", Department of "Ophthalmology and Vision Sciences"

OPHTHALMOLOGICAL PERSPECTIVES ON CHILDREN'S EYE HEALTH

Dr. Slavyana Dimitrova Malcheva-Marinova

ABSTRACT

OF DISSERTATION WORK FOR OBTAINING EDUCATIONAL AND SCIENTIFIC DEGREE 'DOCTOR'

Scientific supervisor:
Assoc. Prof. Dr. Yana Manolova Manolova, MD

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The dissertation contains 148 pages and is illustrated with 39 figures and 23 tables. A total of 255 literary sources are cited, of which 14 are in Cyrillic and 241 are in Latin.

The dissertation has been discussed and proposed for defense at the departmental council of the Department of Ophthalmology and Visual Sciences at the Medical University "Prof. Dr. Paraskev Stoyanov" – Varna.

Scientific jury:

1. Prof. Dr. Snezhana Veselinova Murgova, MD – MU-Pleven
2. Assoc. Prof. Dr. Stanislava Kostova Ivanova, MD – MU-Sofia
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4. Prof. Dr. Zornitsa Ivanova Zlatanova-Angelova, PhD – MU Varna – Chair
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The final meeting of the scientific jury for the defense of the dissertation work of doctoral candidate Dr. Slavyana Dimitrova Malcheva-Marinova will be held on October 9, 2025, at 8:30 AM. The materials for the defense are available at the Research Department of MU-Varna and have been published on the MU-Varna website.

Contents

Note: The numbering of the figures and tables in the abstract does not correspond to the numbering in the dissertation.

1. INTRODUCTION

Early diagnosis and timely treatment are crucial for preserving children's eye health. The awareness of health professionals, the public, and central and local authorities regarding the characteristics of the prevalence of eye diseases in childhood at the local level is of great importance for recognizing the need for effective prevention, tailored to the prevailing ocular pathology in the respective population, and for reducing preventable visual impairments among children. The development and implementation of effective and regular screening programs at the regional level is a prerequisite for creating a positive perspective for the preservation of children's eye health and for reducing the incidence of ophthalmological diseases in adulthood. In different countries around the world, there is significant variability in the prevalence of eye pathology among children, which can be a criterion for the level of development of healthcare and the economy in the respective region.

In developing countries, infections (trachoma, onchocerciasis, toxoplasmosis) and malnutrition (vitamin A deficiency) are among the most common factors leading to vision loss in children, while in high-income countries, lesions of the optic nerve, retinal anomalies, and hereditary eye diseases are predominant. Refractive anomalies are a leading cause of reduced vision globally, both in children and adults.

The increasing prevalence of myopia in childhood is a concerning trend. Children with myopia who do not receive timely ophthalmological care are at risk of developing educational and social difficulties, limited opportunities to practice certain types of sports, as well as other daily activities that require good distance vision. It is also important not to overlook the fact that myopia can be associated with other eye diseases.

A number of scientific studies have found a direct link between lifestyle and the development of myopia, with increased screen time and decreased outdoor activity being highlighted as the main factors. The COVID-19 pandemic and the accompanying anti-epidemic measures have posed new challenges to children's vision. Digital learning has widely entered the educational system and has been established as a teaching method both during the epidemic and when in-person classes were suspended due to adverse weather conditions. Several negative effects of excessive screen time have been identified, affecting both the psycho-social and physical development of children. The strain on the visual system is particularly significant, as children are at risk of developing both temporary complaints - headaches, accommodative disorders, and dry eye syndrome - as well as lasting consequences, such as the development and progression of myopia.

The digitalization of the world presents a contemporary challenge to children's vision. The ophthalmological prospects for children's eye health in today's screen-saturated environment depend on the timely and adequate therapeutic approach of healthcare professionals, accessibility to preventive examinations, and last but not least, the awareness of teachers, parents, and the children themselves regarding the importance of timely prevention and responsible eye care in family and school settings.

2. AIMS AND OBJECTIVES OF THE STUDY

2.1 Aim

Creating an epidemiological picture of childhood eye morbidity in the city of Shumen, monitoring the factors that modulate its characteristics, and formulating recommendations for ensuring positive perspectives for children's eye health, based on the results obtained.

2.2 Objectives

1. Collection of medical information from ophthalmological examinations of children (0-17 years old incl.) from three medical institutions - DCC1 Shumen Ltd, Medical Center in Multi-profile hospital for active treatment- Shumen Ltd and ambulatory practice for specialized medical care – "Dr. Ralitsa Emilova Neykova-Marinova" Ltd.for the period 01.01.2019 - 31.12.2022;
2. Statistical analysis of the distribution of ophthalmological pathology in childhood on the territory of the city of Shumen for each year of the research period and in total for the entire research period;
3. Tracking the dynamics of pediatric eye morbidity in the period before, during and after the COVID-19 pandemic;
4. Comparison of the obtained results with data from studies on the distribution of pediatric eye pathology from foreign and local literary sources;
5. Formulation of recommendations for optimizing ophthalmological screening in childhood;

3. METHODS

This retrospective scientific study is based on information from primary outpatient ophthalmological examinations of children (0-17 years old), for the period 01.01.2019-31.12.2022, conducted by a total of 6 ophthalmologists, on the territory of DCC1 Shumen Ltd, Medical center in Multi-profile hospital for active treatment-Shumen Ltd and ambulatory practice for specialized medical care – "Dr. Ralitsa Emilova Neykova-Marinova" Ltd.

Data was extracted by processing outpatient lists in the pre-hospital medical care software used in the respective medical centers or by processing outpatient lists and journals on paper, stored in an archive.

Inclusion criteria:

- results of outpatient examinations of persons up to and including 17 years of age who underwent a primary eye examination on the territory of the medical care facilities included in the study, for the period 01.01.2019-31.12.2022.

Exclusion criteria:

- results of outpatient examinations of persons over the age of 17 years, inclusive, who underwent a primary eye examination on the territory of the medical care facilities included in the study, for the period 01.01.2019-31.12.2022.

- results of outpatient examinations of persons up to and including 17 years of age who underwent a primary eye examination on the territory of the health facilities for pre-hospital medical care included in the study, outside the period 01.01.2019-31.12.2022.

- results of outpatient examinations of persons up to and including 17 years of age who underwent a secondary eye examination on the territory of the health facilities for pre-hospital medical care included in the study, for the period 01.01.2019-31.12.2022, in cases of duplication of diagnoses with the primary eye examination of the same patient.

The following information was extracted from the outpatient lists – date of examination, age and gender of patient and leading diagnosis, according to the International Classification of Diseases (ICD – 10).

The information from the different medical centers was merged and structured into a database in Excel, after which it was subjected to statistical analysis.

4. RESULTS

For the period from 01.01.2019 to 31.12.2022, a total of 2579 initial ophthalmological examinations of children aged 0 to 17 years, inclusive, have been registered in the territory of DCC1 Shumen Ltd, MC Multi-profile hospital for active treatment- Shumen Ltd and ambulatory practice for specialized medical care – "Dr. Ralitsa Emilova Neykova-Marinova" Ltd. In 2019, 697 individuals were observed, in 2020 - 679, in 2021 - 581, and in 2022 - 622 individuals. According to the observation data, the average age of individuals for each year of the observation period is 10 years of age. The total number of children and their distribution by gender and age for the entire study period is presented in Table 1.

Table 1. Distribution by gender and age of individuals aged 0 to 17 who underwent a primary eye examination during the period 2019-2022 in the medical practices included in the study.

Age	**Gender**		**Total:**
	female	**male**	
0	20	26	46
1	29	40	69
2	28	41	69
3	39	46	85
4	31	39	70
5	33	55	88
6	67	64	131
7	73	77	150
8	89	113	202
9	84	90	174
10	82	76	158
11	121	134	255
12	112	89	201
13	79	69	148
14	99	80	179
15	96	71	167
16	102	72	174
17	126	87	213
Total:	**1310**	**1269**	**2579**

The table shows that a total of 1310 girls and 1269 boys were observed. The largest number of children belongs to the age group of 12-17 years (1082), followed by the group of children aged 6-11 years (1070), while the fewest registered initial eye examinations were among the age group of 0 to 5 years (427).

All registered primary diagnoses from the primary ophthalmological examinations of the studied population are classified into the following groups:

1. Infectious inflammations of the conjunctiva:
- Mucopurulent conjunctivitis
- Other acute conjunctivitis
- Keratoconjunctivitis caused by adenovirus
- Neonatal conjunctivitis and dacryocystitis

2. Inflammatory diseases of the eyelids:
- Blepharitis
- Blepharoconjunctivitis
- Hordeolum and other deep inflammations of the eyelid (for the purpose of facilitating statistical data processing, the diagnosis "Chalazion" is also included in this subgroup)

3. Inflammatory diseases of the cornea, sclera, and uvea:

- Episcleritis
- Iridocyclitis
- Keratitis (this subgroup includes the diagnoses 'Keratitis and keratoconjunctivitis due to herpes simplex virus' and 'Other forms of keratitis')

4. Allergic eye diseases:

- Acute atopic conjunctivitis
- Non-infectious dermatoses of the eyelid

In ICD-10 (International Statistical Classification of Diseases and Related Health Problems), allergic conjunctivitis is represented solely by the diagnosis 'Acute atopic conjunctivitis', with all manifestations of hypersensitivity of the conjunctiva, despite their etiological and clinical diversity, being summarized under this diagnosis – seasonal, perennial, atopic, vernal, giant cell conjunctivitis.

Non-infectious dermatoses of the eyelid include allergic and contact dermatitis, eczematous dermatitis, xeroderma of the eyelids, and dermatitis in lupus erythematosus.

5. Refractive anomalies:

- Hyperopia
- Astigmatism
- Myopia

6. Strabismus:

- Divergent concomitant strabismus
- Convergent concomitant strabismus
- Strabismus, unspecified

7. Tumors:

- Other conjunctival vascular diseases and cysts
- Malignant tumor of the retina
- Hemangioma of the eyelid

8. Accommodative disorders, headache, asthenopia:

- Headache
- Subjective visual disturbances
- Accommodation disorders

9. Traumatic injuries:

- Other superficial injuries of the eyelid and periorbital area
- Contusion of the eyelid and periorbital area
- Contusion of the eyeball and periorbital area
- Open wound of the eyelid and periorbital area
- Thermal burn of the cornea and conjunctival sac
- Trauma of the conjunctiva and contusion of the cornea without mention of a foreign body
- Chemical burning of the cornea and conjunctival sac
- Foreign body in the conjunctival sac
- Foreign body in the cornea

10. Others:
- Amblyopia
- Color vision anomalies
- Optic nerve atrophy
- Congenital glaucoma
- Congenital cataract
- Coloboma of the iris
- Conjunctival hemorrhage
- Preretinopathy
- Congenital ptosis
- Retrobulbar neuritis
- Stenosis and insufficiency of the tear ducts

11. Preventive examination:
- Examination of the eyes and vision

This diagnosis includes preventive ophthalmological examinations in which the patient has no complaints and no pathological deviation is recorded.

Figure 1 presents the distribution of diagnoses by groups for the entire study period (2019-2022). Notably, there is a significant predominance of diagnoses in the group of refractive anomalies, representing 54.31% of the total, while diagnoses related to accommodative disorders, headaches, and asthenopia (11.18%), as well as infectious conjunctival inflammations (10.16%), remain in second and third place, respectively, in terms of prevalence.

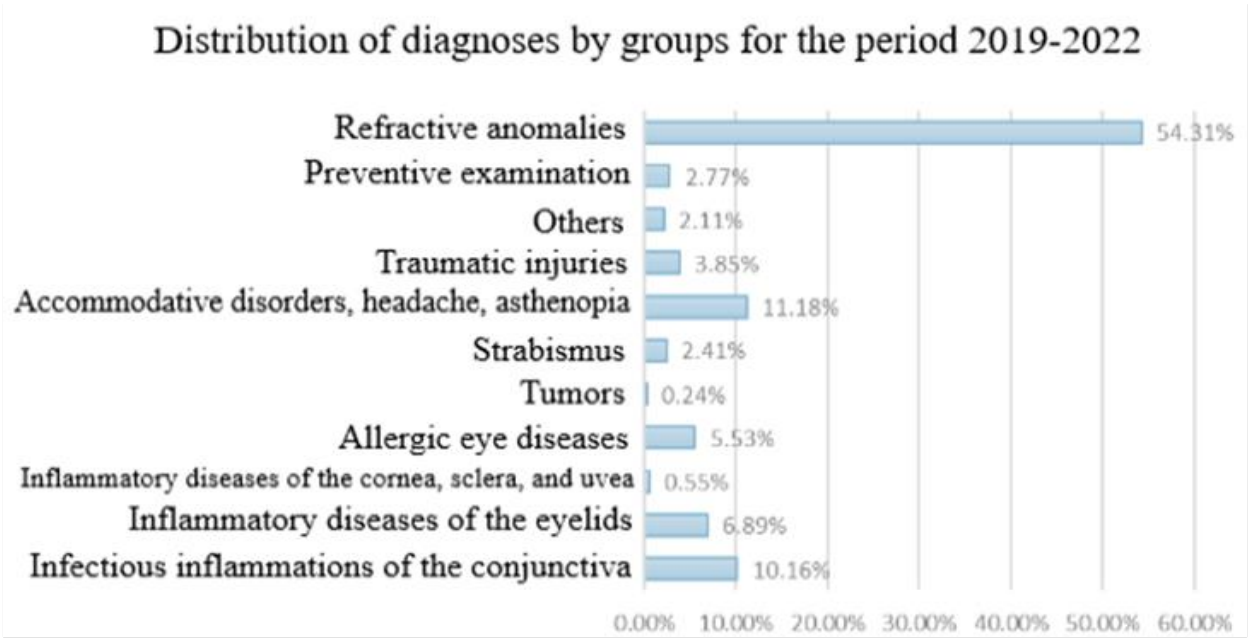

Figure 1. Distribution of diagnoses by groups for the period 2019-2022.

Figure 2 presents the frequency of occurrence of different pathological groups, specifically for 2019. While refractive anomalies were recorded at a frequency very close to the average for the entire study period (54.35%), infectious conjunctivitis

inflammations in 2019 (12.88%) exceeded the average for 2019-2022 (10.16%) and ranked second in frequency after refractive anomalies.

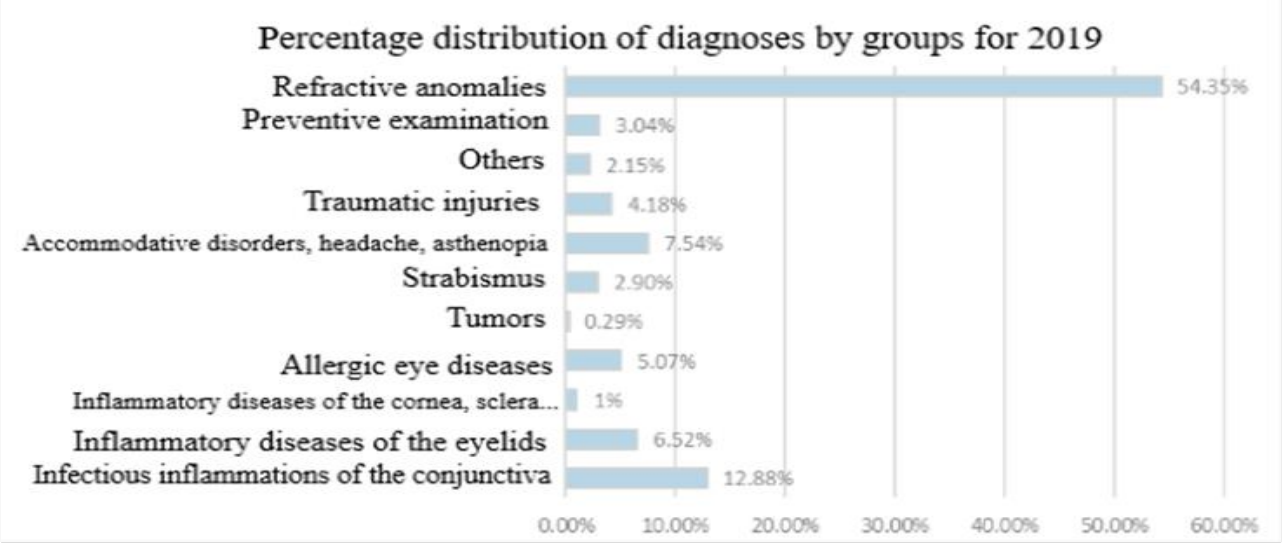

Figure 2. Percentage distribution of diagnoses by groups for 2019.

Similarly, the frequency of occurrence of the studied pathological groups in 2020 is presented in Figure 3. Refractiive anomalies remain predominant (53.83%), and their frequency does not significantly differ from the average for the period or from that reported in 2019. In 2020, however, the second most prevalent group is 'Accommodative disorders, headache, asthenopia' (12.08%), with the recorded cases significantly exceeding those from 2019.

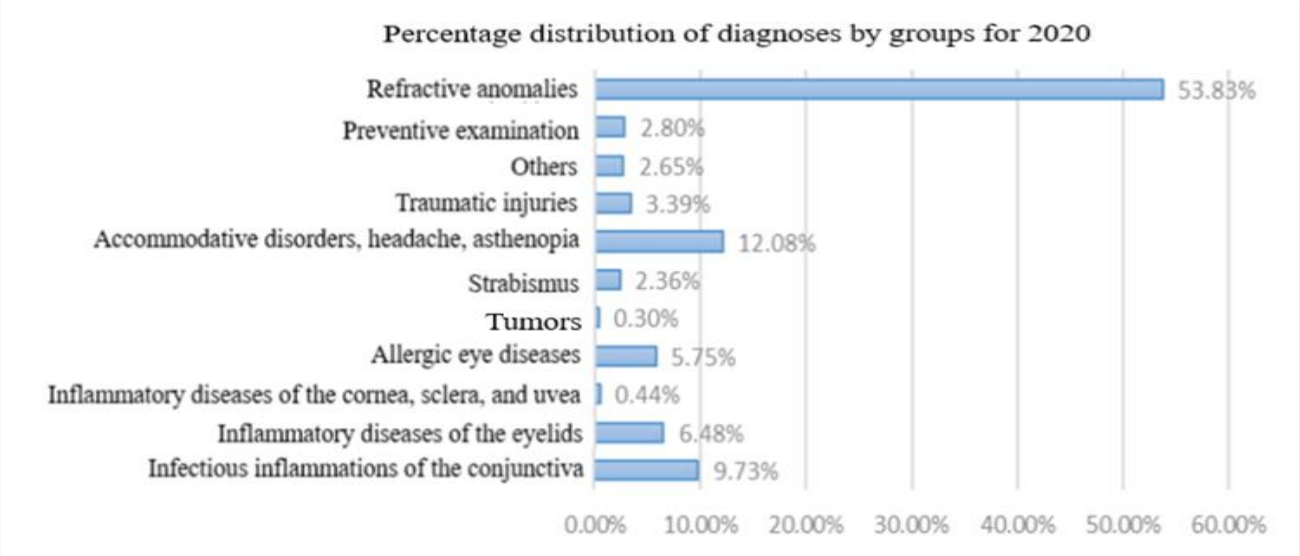

Figure 3. Percentage distribution of diagnoses by groups for 2020.

Figure 4 presents data on the distribution of eye pathology by groups for 2021. Diagnoses from the group "Refractive anomalies" remain dominant as always, but in 2021 they were recorded more frequently (55.08%) than in previous years of the study period. The group "Accommodative disorders, headaches, asthenopia" again ranks second in frequency (as in 2020 and for the period 2019-2022), but with a higher prevalence compared to the previous year (13.25%).

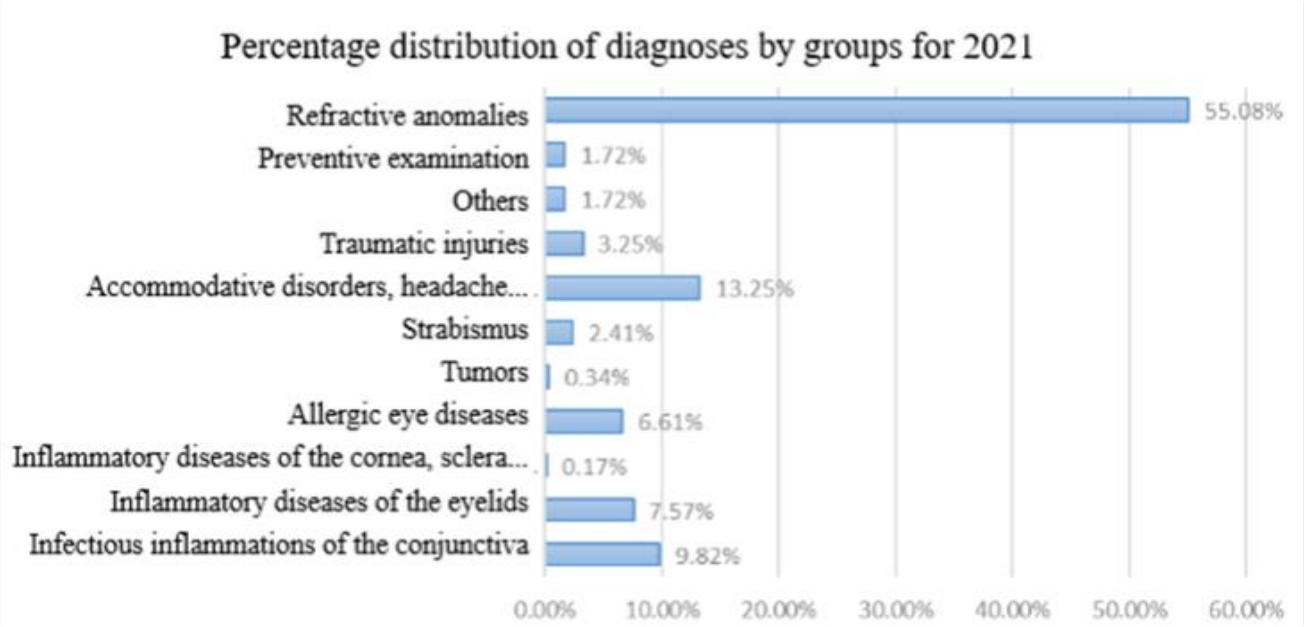

Figure 4. Percentage distribution of diagnoses by groups for 2021.

The frequency of diagnoses by groups for the year 2022 is presented in Figure 5. Refraction anomalies show a slight decrease (54.04%) compared to the previous year, but the group "Accommodative disorders, headache, asthenopia" maintains its high frequency, ranking second in prevalence (13.25%). Infectious conjunctival inflammations occur less frequently than in the previous year (7.91%), nearly equal in frequency to eyelid inflammations (7.10%). Unlike previous years included in the study, no leading diagnosis from the "Tumors" group was registered in 2022.

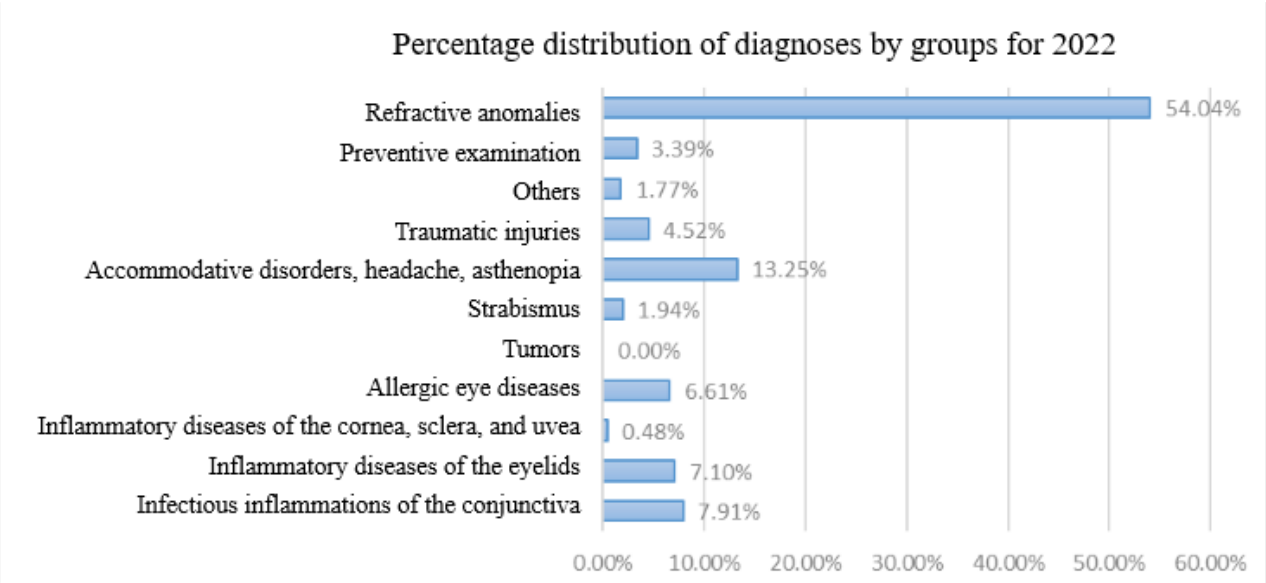

Figure 5. Percentage distribution of diagnoses by groups for 2022.

Following the examination of the percentage distribution of the disease groups under consideration for each year of the study period, the subsequent tables presentthe frequency of the leading diagnoses within each of the groups.

The results regarding the percentage distribution of diagnoses in the group 'Infectious inflammations of the conjunctiva' for each year of the covered period are presented in Table 2. The number of children diagnosed with the respective leading diagnosis is indicated in parentheses.

Table 2. Percentage distribution of diagnoses in the group 'Inflammatory Diseases of the Conjunctiva' for each year of the study period.

Infectious inflammations of the conjunctiva	**Year**				**On average for the entire period**
	2019	**2020**	**2021**	**2022**	
Other acute conjunctivitis	3.32% (23)	2.65% (18)	2.93% (17)	0.00%	2.26%
Keratoconjunctivitis caused by adenovirus	1.88% (13)	1.03% (7)	1.38% (8)	2.10% (13)	1.60%
Mucopurulent conjunctivi-tis	7.39% (51)	5.90% (40)	5.34% (31)	5.65% (35)	6.11%
Neonatal conjunctivitis and dacryocystitis	0.29% (2)	0.15% (1)	0.17% (1)	0.16% (1)	0.19%
Total:	12.88%	9.73%	9.82%	7.91%	10.16%

The table shows that the leading diagnosis among 12.88% of the examined children for the year 2019 falls within the group "Infectious Inflammation of the Conjunctiva." In 2020, there is a significant decrease in the frequency of conjunctival inflammations, with only 9.73% of pediatric ophthalmological examinations conducted for conjunctivitis. In the following years, this trend continues, with cases of infectious conjunctival inflammation declining to 7.91% by the end of the study period. The percentage frequency of occurrence for each diagnosis in the group "Infectious Inflammation of the Conjunctiva" for the entire study period is indicated in the last column of the table. For instance, the diagnosis of "Mucopurulent Conjunctivitis" accounts for 6.11% of all leading diagnoses in childhood during the period from 2019 to 2022, and it predominates in the group of conjunctival inflammations throughout all examined years.

The data on the percentage distribution of various leading diagnoses in the group 'Inflammatory Diseases of the Eyelids' within the studied population is presented in Table 3.

Table 3. The percentage distribution of the leading diagnoses in the group 'Inflammatory Diseases of the Eyelids' for each year of the study period.

Inflammatory diseases of the eyelids	Year				On average for the entire period
	2019	2020	2021	2022	
Blepharitis	1.16% (8)	0.44% (3)	0.00%	0.81% (5)	0.62%
Blepharoconjunctivitis	1.01% (7)	1.47% (10)	1.20% (7)	0.81% (5)	1.13%
Hordeolum and other deep inflammations of the eyelid	4.35% (30)	4.57% (31)	6.37% (37)	5.48% (34)	5.14%
Total:	**6.52%**	**6.48%**	**7.57%**	**7.10%**	**6.89%**

The data from the table indicates a relatively constant frequency of eyelid inflammations among children during the study period, ranging between 6.52% and 7.57%.

The prevalence of inflammatory diseases of the cornea, sclera, and uvea among children aged 0 to 17 years during the study period is presented in Table 4. Inflammations of the corneosclera and uvea were most frequently recorded in 2019 (1%), and least frequently in 2021 (0.17%).

Table 4. Percentage distribution of the leading diagnoses in the group 'Inflammatory Diseases of the Cornea, Sclera, and Uvea' for each year of the study period.

Inflammatory diseases of the cornea, sclera, and uvea	Year				On average for the entire period
	2019	2020	2021	2022	
Keratitis	0.43% (3)	0.29% (2)	0.00%	0.48% (3)	0.31%
Episcleritis	0.14% (1)	0.15% (1)	0.17% (1)	0.00%	0.12%
Iridocyclitis	0.43% (3)	0.00%	0.00%	0.00%	0.12%
Total:	**1.00%**	**0.44%**	**0.17%**	**0.48%**	**0.55%**

Table 5 presents the results regarding the percentage distribution of diagnoses in the group "Allergic Eye Diseases" for the period 2019-2022. The data indicate that allergic conditions affecting the organ of vision most frequently manifest as allergic conjunctivitis, while occurrences of eyelid dermatitis are much rarer. In 2022, an increase in the incidence of allergic conjunctivitis was recorded, surpassing the number of cases from previous years.

Table 5. Percentage distribution of the leading diagnoses in the group 'Allergic Eye Diseases' for each year of the study period.

Allergic eye diseases	**Year**				**On average for the entire period**
	2019	**2020**	**2021**	**2022**	
Non-infectious dermatoses of the eyelid	0.14% (1)	0.59% (4)	0.52% (3)	0.32% (2)	0.39%
Acute atopic conjunctivitis	4.93% (34)	5.16% (35)	4.13% (24)	6.29% (39)	5.14%
Total:	**5.07%**	**5.75%**	**4.65%**	**6.61%**	**5.53%**

The frequency of the diagnoses 'Astigmatism', 'Hyperopia', and 'Myopia' for the studied period are presented in Table 6. There is a dynamic in the distribution of diagnoses in the group. In each of the studied years, myopic refraction is the most prevalent, with the diagnosis 'Myopia' showing a trend of continuous increase from the beginning to the end of the study period. Astigmatism is second in frequency in the group (16.82% for the entire period), with the highest number of cases recorded in 2019 (126). After a slight decline in 2020, in 2021 its frequency again increases, but by the end of the period, a decrease in the number of children with the primary diagnosis 'Astigmatism' is again observed. The overall trend is a decrease in the frequency of the spread of this diagnosis from the beginning to the end of the period 2019-2022. Hyperopia is the least commonly encountered leading diagnosis within the group of refractive anomalies, although its prevalence is quite close to that of astigmatism (16.43% and 16.82% respectively for the entire period). The prevalence of the diagnosis 'Hyperopia' remained relatively constant for 2019 and 2020 (17.54% and 17.99% respectively), but over the next two years, it experienced a decline, reaching 14.68% in 2022.

Table 6. Percentage distribution of the leading diagnoses in the group 'Refraction Anomalies' for each year of the study period.

Refractive anomalies	**Year**				**On average for the entire period**
	2019	**2020**	**2021**	**2022**	
Astigmatism	18.26% (126)	15.93% (108)	17.21% (100)	15.81% (98)	16.82%
Myopia	18.55% (128)	19.91% (135)	22.72% (132)	23.55% (146)	21.06%
Hyperopia	17.54% (121)	17.99% (122)	15.15% (88)	14.68% (91)	16.43%
Total:	**54.35%**	**53.83%**	**55.08%**	**54.04%**	**54.31%**

Table 7 presents the distribution of diagnoses within the group "Tumors" . These are the diseases with the lowest prevalence in the studied population for the period 2019-2022. The most commonly encountered diagnosis in this group is "Other conjunctival vascular diseases and cysts," which constitutes 0.16% of all diagnoses for the entire period. This leading diagnosis was recorded for 2 children in 2019, and for 2020 and 2021, there was 1 child diagnosed each year. A malignant tumor of the retina was identified once during the entire study period, with the case being registered in 2020. Additionally, one child was diagnosed with a hemangioma of the eyelid, with the diagnosis being made in 2021. In 2022, no children with a leading diagnosis from the tumor diseases group were observed.

Table 7. Percentage distribution of the leading diagnoses in the "Tumors" group for each year of the study period.

Tumors		**Year**			**On average for the entire period**
	2019	**2020**	**2021**	**2022**	
Other conjunctival vascular diseases and cysts	0.29% (2)	0.15% (1)	0.17% (1)	0.00%	0.16%
Malignant tumor of the retina	0.00%	0.15% (1)	0.00%	0.00%	0.04%
Hemangioma of the eyelid	0.00%	0.00%	0.17% (1)	0.00%	0.04%
Total:	**0.29%**	**0.30%**	**0.34%**	**0.00%**	**0.24%**

The results regarding the percentage distribution of diagnoses in the “Strabismus” group for each year of the covered period are presented in Table 8.

Table 8. Percentage distribution of the leading diagnoses in the "Strabismus" group for each year of the study period.

Strabismus	**Year**				**On average for the entire period**
	2019	**2020**	**2021**	**2022**	
Divergent concomitant strabismus	0.58%	0.44%	0.17%	0.16%	0.35%
Convergent concomitant strabismus	1.74%	1.33%	1.38%	1.13%	1.40%
Strabismus, unspecified	0.58% (4)	0.59% (4)	0.86% (5)	0.65% (4)	0.66%
Total:	**2.90%**	**2.36%**	**2.41%**	**1.94%**	**2.41%**

According to the data obtained, strabismus was the most common at the beginning of the study period, accounting for 2.9% of all leading diagnoses in 2019. Its frequency decreased in 2020 (2.36%) and remained relatively constant in the following year. At the end of the period, a decrease in the prevalence of strabismus among the study population was again recorded, with less than 2% of the studied children (1.94%) having such a leading diagnosis.

The prevalence of various types of traumatic injuries among children up to 17 years of age for the period 2019-2022 is presented in Table 9. According to the data obtained, the total frequency of traumatic injuries in the study population was highest at the beginning and end of the period (4.18% in 2019 and 4.52% in 2022, respectively), and in 2020 and 2021. diagnoses from this group are less common.

Table 9. Percentage distribution of the leading diagnoses in the group "Traumatic injuries" for each year of the study period.

Traumatic injuries	**Year**				**On average for the entire period**
	2019	**2020**	**2021**	**2022**	
Other superficial injuries of eyelid and periocular area	0.29% (2)	0.15% (1)	0.34% (2)	0.65% (4)	0.35%
Contusion of the eyelid and periorbital area	1.30% (9)	0.74% (5)	0.69% (4)	0.65% (4)	0.86%
Contusion of the eyeball and periorbital area	0.43% (3)	0.44% (3)	0.17% (1)	0.48% (3)	0.39%
Open wound on the eyelid and periorbital area	0.14% (1)	0.15% (1)	0.00%	0.00%	0.08%
Thermal burn of the cornea and conjunctival sac	0.00%	0.00%	0.17% (1)	0.00%	0.04%
Trauma of conjunctiva and contusion of cornea without mention of foreign body	1.01% (7)	1.03% (7)	1.03% (6)	1.13% (7)	1.05%
Chemical burning of the cornea and conjunctival sac	0.29% (2)	0.29% (2)	0.17% (1)	0.32% (2)	0.27%
Foreign body in the conjunctival sac	0.43% (3)	0.44% (3)	0.34% (2)	1.13% (7)	0.58%
Foreign body in the cornea	0.29% (2)	0.15% (1)	0.34% (2)	0.16% (1)	0.23%
Total:	**4.18%**	**3.39%**	**3.25%**	**4.52%**	**3.85%**

Table 10 shows the distribution of diagnoses in the group "Accommodative disorders, headache, asthenopia" for the period 2019 - 2022. The diagnosis "Accommodative disorders" prevails over the other diagnoses in the group in each year of the study period, with subjective visual disorders being the second most frequent (6.62%), and the diagnosis "Headache" being the least frequently registered (0.86%). The prevalence of subjective visual disturances is lowest at the beginning of the study period (2.32%).

Table 10. Percentage distribution of the leading diagnoses in the group "Accommodative disorders, headache, asthenopia" for each year of the study period

"Accommodative disorders, headache, asthenopia"	**Year**				**On average for the entire period**
	2019	**2020**	**2021**	**2022**	
Headache	0.29% (2)	0.88% (6)	1.20% (7)	1.13% (7)	0.86%
Accommodative disorders	4.93% (34)	6.19% (42)	7.57% (44)	8.06% (50)	6.62%
Subjective visual disturances	2.32% (16)	5.01% (34)	4.48% (26)	3.06% (19)	3.70%
Total:	**7.54%**	**12.08%**	**13.25%**	**12.25%**	**11.18%**

Table 11 presents the prevalence of the leading diagnoses that cannot be assigned to the other groups, including congenital diseases, amblyopia, color vision abnormalities, lacrimal duct stenosis, conjunctival hemorrhage, as well as other rare but significant childhood diseases affecting the optic nerve and retina.

Table 11. Percentage distribution of leading diagnoses in the "Others" group for each year of the study period.

Others	Year				On average for the entire period
	2019	2020	2021	2022	
Amblyopia	0.43% (3)	0.88% (6)	0.69% (4)	0.48% (3)	0.62%
Color vision anomalies	0.00%	0.15% (1)	0.17% (1)	0.00%	0.08%
Optic nerve atrophy	0.00%	0.00%	0.17% (1)	0.00%	0.04%
Congenital glaucoma	0.00%	0.15% (1)	0.00%	0.00%	0.04%
Congenital cataract	0.14% (1)	0.00%	0.00%	0.16% (1)	0.08%
Coloboma of the iris	0.14% (1)	0.00%	0.00%	0.00%	0.04%
Conjunctival hemor-rhage	0.14% (1)	0.44% (3)	0.00%	0.16% (1)	0.19%
Preretinopathy	0.00%	0.29% (2)	0.00%	0.00%	0.08%
Congenital ptosis	0.29% (2)	0.00%	0.00%	0.00%	0.08%
Retrobulbar neuritis	0.14% (1)	0.00%	0.00%	0.00%	0.04%
Stenosis and insuffi-ciency of the tear ducts	0.87% (6)	0.74% (5)	0.69% (4)	0.97% (6)	0.82%
Total:	**2.15%**	**2.65%**	**1.72%**	**1.77%**	**2.11%**

Table 12 presents data on the frequency of preventive ophthalmological examinations, in which no pathology was reported. Slightly over 3% of the surveyed population in 2019 had a leading diagnosis of "Examination of eyes and vision". In 2020, a slight decrease in the frequency of preventive examinations (2.80%) was reported. A significant decrease in the frequency of this diagnosis was observed in 2021, with only 10 children (1.72%) undergoing a preventive eye examination this year. At the end of the period, an increase in the frequency of preventive examinations (3.39%) was observed, even exceeding that of 2019.

Table 12. Percentage distribution of the leading diagnoses in the "Preventive examination" group for each year of the study period.

Preventive examination	Year				On average for the entire period
	2019	2020	2021	2022	
Examination of eyes and vision	3.04% (21)	2.80% (19)	1.72% (10)	3.39% (21)	2.77%

The following tables present information on the frequency of registered leading diagnoses in males and females in different age groups (0 – 5 years, 6 – 11 years, 12 – 17 years).

Table 13. Percentage distribution of the leading diagnoses in the group "Infectious inflammations of the conjunctiva" among female and male individuals in the considered age groups.

Infectious inflammations of the conjunctiva	Age groups								
	0-5			6-11			12-17		
	female	male	total	female	male	total	female	male	total
Other acute conjunctivitis	3.07%	4.98%	8.05%	4.59%	1.91%	6.50%	4.21%	3.44%	7.65%
Kerato-conjuncti-vitis caused by adenovirus	0.00%	1.91%	1.91%	2.69%	5.75%	8.44%	2.68%	2.69%	5.37%
Mucopurulent conjunctivitis	11.88%	21.46%	33.34%	7.66%	9.21%	16.87%	7.67%	2.30%	9.97%
Neonatal conjunctivitis and dacryocystitis	0.77%	1.15%	1.92%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Total:	**15.72%**	**29.50%**	**45.22%**	**14.94%**	**16.87%**	**31.81%**	**14.56%**	**8.43%**	**22.99%**

Table 13 reflects the distribution of infectious conjunctivitis according to the age and gender of the individuals in the studied population. It is clear that infectious conjunctivitis was most common in the group of children from 0 to 5 years of age (45.22%) and least common in the group of 12-17 years of age, in which the frequency of conjunctivitis was almost two times lower (22.99%). When considering the distribution by gender in the general population (0-17 years), a higher frequency

of infectious conjunctivitis was observed in boys compared to girls (54.8% and 45.2%, respectively).

Table 14. Percentage distribution of the leading diagnoses in the group "Inflammatory diseases of the eyelids" among female and male individuals in the considered age groups.

Inflamatory diseases of the eyelids	**Age groups**								
	0-5			**6-11**			**12-17**		
	female	**male**	**total**	**female**	**male**	**total**	**female**	**male**	**total**
Blepharitis	0.56%	0.00%	0.56%	2.26%	2.25%	4.51%	1.68%	2.25 %	3.93%
Blepharo-conjunctivitis	1.13%	0.00%	1.13%	5.08%	3.38%	8.46%	3.37%	3.37 %	6.74%
Hordeolum and other deep inflammations of the eyelids	16.93 %	17.49 %	34.42 %	13.55 %	10.72 %	24.27 %	12.42 %	3.56 %	15.98 %
Total:	**18.62 %**	**17.49 %**	**36.11 %**	**20.89 %**	**16.35 %**	**37.24 %**	**17.47 %**	**9.18 %**	**26.65 %**

Table 14 presents the frequency of the leading diagnoses in the group of eyelid inflammations among girls and boys in different age groups for the entire study period. Eyelid inflammations occur with approximately the same frequency in children up to 5 years old and those between 6 and 11 years old (36.11% and 37.24%, respectively) and less frequently in teenagers (26.65%).

Table 15. Percentage distribution of the leading diagnoses in the group "Inflammatory diseases of the cornea, sclera and uvea" among female and male individuals in the considered age groups.

Inflammatory diseases of the cornea, sclera and uvea	**Age groups**				
	6-11		**12-17**		
	male	**total**	**female**	**male**	**total**
Keratitis	0.00%	0.00%	21.44%	35.71%	57.15%
Episcleritis	0.00%	0.00%	7.14%	14.29%	21.43%
Iridocyclitis	7.14%	7.14%	7.14%	7.14%	14.28%
Total:	**7.14%**	**7.14%**	**35.72%**	**57.14%**	**92.86%**

Table 15 shows that inflammatory diseases of the sclera and uvea were observed only in persons over 6 years of age. Among children aged 6-11 years. were

registered only in males, and of the three diagnoses in the group, only iridocyclitis was found. In 12-17 year olds, all diagnoses from the group were found, with keratitis being the most common (57.15%), episcleritis in second place (21.43%), and iridocyclitis being the least common (7.14%). While keratitis and episcleritis are more common in males in the 12-17 year old group, there is no difference in frequency between the sexes for iridocyclitis.

Table 16. Percentage distribution of the leading diagnoses in the group "Allergic eye diseases" among female and male individuals in the considered age groups.

Allergic eye diseases	**Age groups**								
	0-5			**6-11**			**12-17**		
	female	**male**	**total**	**female**	**male**	**total**	**female**	**male**	**total**
Acute atopic conjunctivitis	0.00%	0.00%	0.00%	0.00%	2.81%	2.81 %	2.11%	2.11 %	4.22%
Non-infectious dermatoses of the eyelid	16.91 %	12.68 %	29.59 %	19.72 %	24.65 %	44.37 %	11.27 %	7.74 %	19.01 %
Total:	**16.91 %**	**12.68 %**	**29.59 %**	**19.72 %**	**27.46 %**	**47.18 %**	**13.38 %**	**9.85 %**	**23.23 %**

According to the data presented in Table 16, allergic eye inflammations are most common in the age group between 6 and 11 years (47.18%), with males (24.65%) more affected than females (19.72%). Eye allergies are least common among 12-17 year olds, with eyelid involvement occurring equally frequently in both sexes, and allergic conjunctivitis being more common in girls. In the general population (0-17 years), we find equal involvement in girls and boys (50.01% and 49.99%, respectively).

Table 17. Percentage distribution of the leading diagnoses in the group "Refractive anomalies" among female and male individuals in the considered age groups.

Refractive anomalies	**Age groups**								
	0-5			**6-11**			**12-17**		
	female	**male**	**total**	**female**	**male**	**total**	**female**	**male**	**total**
Astigmatism	0.72 %	1.0%	1.72 %	5.08%	7.11%	12.19 %	9.85%	7.25%	17.10 %
Myopia	0.00 %	0.21 %	0.21 %	7.46%	7.46%	14.92 %	13.48 %	10.18 %	23.66 %
Hyperopia	1.38 %	1.51 %	2.89 %	7.74%	8.39%	16.13 %	7.30%	3.88%	11.26 %
Total:	**2.10 %**	**2.72 %**	**4.82 %**	**20.28 %**	**22.96 %**	**43.24 %**	**30.63 %**	**21.31 %**	**51.94 %**

The frequency of refractive errors in boys and girls in the considered age groups is presented in Table 17. With increasing age, the frequency of refractive errors also increases, with children aged 12-17 years old being the most frequently registered (51.94%), and children under 5 years old being the least frequently registered (4.82%). In the youngest children (0-5 years old), the predominant refraction is hypermetropic (2.89%). Astigmatism is less common (1.72%), and myopia is registered in only 0.21% of eye examinations in this age group. No significant differences in the frequency of diagnoses are observed in boys and girls.

The most common refractive error in the group of 6-11 year olds is hypermetropia (16.13%). The second most common is myopia (14.92%), and the least common is astigmatism (12.19%). Males and females do not show significant differences in refractive errors. The steep increase in the frequency of myopia in this age group is striking, and despite this, hyperopia is still more common in children between 6 and 11 years.

Among the oldest, the frequency of myopia continues to increase, being the leading refractive error among 12-17 year olds (23.66%). Astigmatism is second most common (17.10%), and hyperopia is third (11.26%). In this age group, all refractive errors are registered more often in females.

Table 18. Percentage distribution of the leading diagnoses in the group "Accommodative disorders, headache, asthenopia" among female and male individuals in the considered age groups.

Accommodative disorders, headache, asthenopia	**Age groups**								
	0-5			**6-11**			**12-17**		
	female	**male**	**total**	**female**	**male**	**total**	**female**	**male**	**total**
Headache	0.35 %	0.00 %	0.35 %	1.05%	2.45%	3.50%	1.68%	2.45%	4.13%
Acommodation disorders	1.75 %	2.10 %	3.85 %	15.68 %	11.84 %	27.52 %	16.02 %	11.85 %	27.87 %
Subjective visual disturbances	0.00 %	2.79 %	2.79 %	9.76%	8.71%	18.47 %	6.63%	4.89%	11.52 %
Total:	**2.10 %**	**4.89 %**	**6.99 %**	**26.49 %**	**23.00 %**	**49.49 %**	**24.33 %**	**19.19 %**	**43.52 %**

Table 18 presents the frequency of diagnoses from the group “Accommodative disorders, headache, asthenopia” in males and females in different age groups. Diagnoses from this group are most common in the group of children between 6 and 11 years old (49.49%), and are least often observed in the youngest children (6.99% of all registered diagnoses in the group).

Table 19. Percentage distribution of the leading diagnoses in the group "Tumorous diseases" among female and male individuals in the considered age groups.

Tumorous diseases	**Age groups**					
	0-5		**6-11**		**12-17**	
	female	**total**	**male**	**total**	**female**	**total**
Other conjunctival vascular diseases and cysts	0.00%	0.00%	50.00%	50.00%	16.67%	16.67%
Malignant tumor of the retina	16.67%	16.67%	0.00%	0.00%	0.00%	0.00%
Hemangioma of the eyelid	16.67%	16.67%	0.00%	0.00%	0.00%	0.00%
Total:	**33.34%**	**33.34%**	**50.00%**	**50.00%**	**16.67%**	**16.67%**

Table 19 presents the frequency of ophthalmological tumor diseases among males and females in the considered age groups. In males up to 5 years of age, no ocular tumors were registered. The diagnosis “Other conjunctival vascular diseases and cysts” does not appear in this age group. “Malignant tumor of the retina” and “Hemangioma of the eyelid” are diagnoses available only in children from 0 to 5 years, with cases registered in females.

In the group of 6-11-year-old children, ocular tumors are most common compared to other age groups, with cases of “Other conjunctival vascular diseases and cysts” registered only in boys.

In adolescents (12-17 years) the same diagnosis was found only in females.

Table 20. Percentage distribution of the leading diagnoses in the "Strabismus" group among female and male individuals in the considered age groups.

Strabismus	**Age groups**								
	0-5			**6-11**			**12-17**		
	fe-male	**male**	**total**	**fe-male**	**male**	**total**	**fe-male**	**male**	**total**
Divergent concomitant strabismus	0.00%	0.00%	0.00%	0.00 %	1.61%	1.61%	6.44%	4.83 %	11.27 %
Convergent concomitant strabismus	12.96 %	17.74 %	30.70 %	8.05 %	11.29 %	19.34 %	6.45%	3.22 %	9.67%
Strabisumu, unspecified	11.29 %	12.90 %	24.19 %	1.61 %	1.61%	3.22%	0.00%	0.00 %	0.00%
Total:	**24.25 %**	**30.64 %**	**54.89 %**	**9.66 %**	**14.51 %**	**24.17 %**	**12.89 %**	**8.05 %**	**20.94 %**

Table 20 presents the distribution of diagnoses in the "Strabismus" group by gender and age in the studied population, for the studied period. Strabismus is most often found among children up to 5 years of age, with males being registered more often with diagnoses from this group. Strabismus occurs less frequently with increasing age, with its distribution in the groups 6-11 years. and 12-17 years. being close (respectively 24.17% and 20.94%), but with a frequency much lower than that in children up to 5 years. (54.89% of all cases of strabismus).

Table 21. Percentage distribution of the leading diagnoses in the group "Traumatic injuries" among female and male individuals in the considered age groups.

Traumatic injuries	**Age groups**								
	0-5			**6-11**			**12-17**		
	female	**male**	**total**	**female**	**male**	**total**	**female**	**male**	**total**
Other superficial injuries of the eyelid and periorbital area	0.00%	2.02%	2.02%	1.01%	2.02%	3.03%	1.01%	3.03%	4.04 %
Contusion of the eyelid and periorbital area	3.03%	5.05%	8.08%	3.03%	4.04%	7.07%	2.02%	5.05%	7.07%
Contusion of the eyeball and periorbital area	0.00%	0.00%	0.00%	0.00%	4.04%	4.04%	1.01%	4.04%	5.05%
Open wound of the eye and periorbital area	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.02%	2.02%
Thermal burn of the cornea and conjunctival sac	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.01%	0.00%	1.01%
Trauma of the conjunctiva and contusion of the cornea without mention of a foreign body	5.05%	6.06%	11.11%	3.03%	5.87 %	8.90%	2.02%	3.23%	5.25%
Chemical burn of the cornea and conjunctival sac	0.00%	1.01%	1.01%	1.01%	2.02%	3.03%	0.00%	0.0%	0.00%
Foreign body in the conjunctival sac	0.00%	3.03%	3.03%	2.02%	5.05%	7.07%	3.03%	8.08%	11.11%
Foreign body in the cornea	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.02%	4.04%	6.06%
Total:	**8.08%**	**17.17%**	**25.25%**	**10.10%**	**23.04%**	**33.14%**	**12.12%**	**29.49%**	**41.61%**

The frequency of different types of traumatic eye injuries in boys and girls in the considered age groups is presented in Table 21. According to the data obtained, eye trauma is most common among children between 12 and 17 years of age and least common in children from 0 to 5 years. The male gender is more affected by eye injuries in all age subgroups.

Table 22. Percentage distribution of the leading diagnoses in the "Others" group among female and male individuals in the considered age groups.

Others	**Age groups**								
	0-5			**6-11**			**12-17**		
	female	**male**	**total**	**female**	**male**	**total**	**female**	**male**	**total**
Amblyopia	0.00 %	1.85%	1.85%	9.25%	9.25%	18.50 %	1.85 %	7.40%	9.25%
Color vision anomalies	0.00 %	0.00%	0.00%	0.00%	1.85%	1.85%	0.00 %	1.85%	1.85%
Optic nerve atrophy	0.00 %	0.00%	0.00%	0.00%	0.00%	0.00%	0.00 %	3.70%	3.70%
Congenital glaucoma	0.00 %	1.85%	1.85%	0.00%	0.00%	0.00%	0.00 %	0.00%	0.00%
Congenital cataract	0.00 %	0.00%	0.00%	0.00%	3.70%	3.70%	0.00 %	0.00%	0.00%
Coloboma of the iris	0.00 %	0.00%	0.00%	0.00%	0.00%	0.00%	0.00 %	1.85%	1.85%
Conjunctival hemorrhage	0.00 %	0.00%	0.00%	1.85%	0.00%	1.85%	0.00 %	5.62%	5.62%
Preretinopathy	0.00 %	1.85%	1.85%	0.00%	1.85%	1.85%	0.00 %	0.00%	0.00%
Congenital ptosis	1.85 %	1.85%	3.70%	0.00%	0.00%	0.00%	0.00 %	0.00%	0.00%
Retrobulbar neuritis	0.00 %	0.00%	0.00%	0.00%	0.00%	0.00%	1.85 %	0.00%	1.85%
Stenosis and insufficiency of the tear ducts	14.81 %	24.07 %	38.88 %	0.00%	0.00%	0.00%	0.00 %	0.00%	0.00%
Total:	**16.66 %**	**31.47 %**	**48.13 %**	**11.10 %**	**16.65 %**	**27.75 %**	**3.70 %**	**20.42 %**	**24.12 %**

Table 22 presents the distribution by gender and age in the studied population of the diagnoses classified in the “Other” group. From the data indicated in Table 22, it is clear that amblyopia occurs as a leading diagnosis most often in the group of 6-11-year-old children, with equal frequency in both sexes. In 12-17-year-olds it occurs less often (more often in boys), and is most rare in the group of children up to 5 years.

Color vision abnormalities were registered only in boys, equally often in the group of 6-11-year-olds and in the group of adolescents. In youngest children, no cases of this pathology were recorded for the studied period.

Optic nerve atrophy was found only in males, aged between 12 and 17.

Congenital glaucoma was also diagnosed only in males and only in the youngest children.

Cases of congenital cataract were registered only in the age group 6-11 years, again only in boys.

Iris coloboma was rarely observed in the studied population for the period 2019-2022 - in one child or 1.85% of all cases in the considered group, and the child was male and in adolescence.

Conjunctival hemorrhage was not registered in children under 5 years of age. It is most common in the group of 12-17 years old (more often in boys), and in 6-11 years old it occurs less often (a single case in a female person).

Congenital ptosis was also diagnosed only in boys, in the age groups 0-5 years. and 6-11 years.

Preretinopathy (PR) is expected to occur only in the youngest, with no differences in frequency between the sexes.

Retrobulbar neuritis was listed as the leading diagnosis once during the entire study period, in an adolescent female child.

Lacrimal duct stenosis and insufficiency occurred in both sexes in the 0-5 year old group, more frequently in boys. This diagnosis was not found in other age groups.

Table 23. Percentage distribution of the leading diagnoses in the "Preventive examination" group among female and male individuals in the considered age groups.

Preventive examination	**Age groups**								
	0-5			**6-11**			**12-17**		
	female	**male**	**total**	**female**	**male**	**total**	**female**	**male**	**total**
Examination of the eyes and vision	18.32 %	22.53 %	40.85 %	22.55 %	12.69 %	35.24 %	14.04 %	9.87 %	23.91 %

Table 23 presents the frequency of preventive eye examinations among male and female children in different age groups. According to the survey data, with increasing age, the frequency of the diagnosis “Eye and vision examination” in the studied population also decreases, with children up to 5 years of age (more often boys) undergoing the most preventive eye examinations, and children between 12 and 17

years of age - the least. In the above two age groups, girls underwent preventive eye examinations more often than boys.

The distribution of leading diagnoses from primary ophthalmological examinations in each of the considered age groups, for each year of the period 2019-2022, is presented in the following figures.

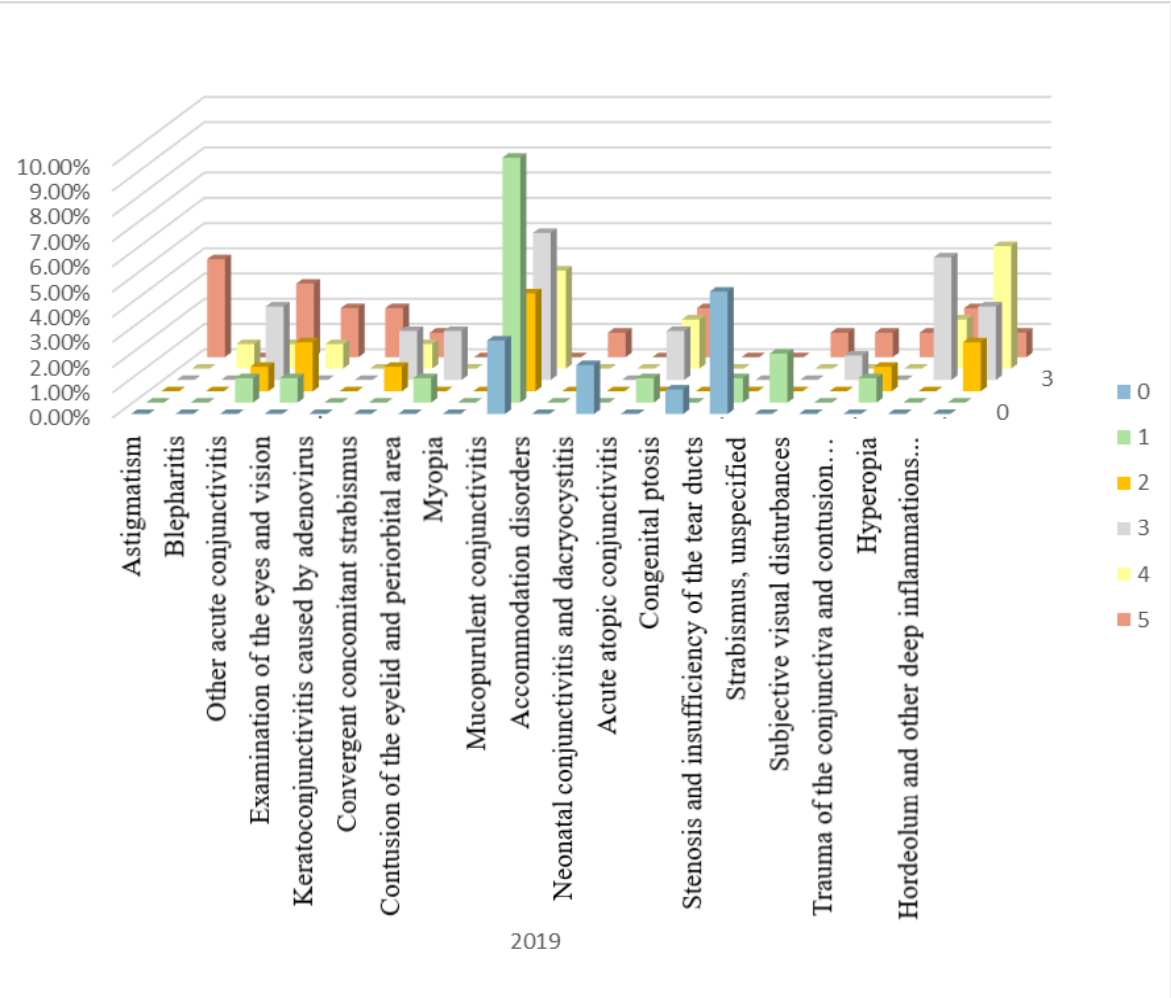

Figure 6. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 0-5 years, for 2019.

Figure 6 presents the frequency of leading diagnoses in 2019 in the age group from 0 to 5 years. Four leading diagnoses were observed in children under one year of age, with the most common being lacrimal duct stenosis, followed by mucopurulent conjunctivitis. Other, less frequently recorded diagnoses include “Neonatal conjunctivitis and dacryocystitis” and “Congenital ptosis”, which are only found in children under 1 year of age.

Children aged 1, who underwent an eye examination in 2019 were most often diagnosed with “Mucopurulent conjunctivitis”.

In 2019, two-year-old children visited an ophthalmologist most often due to infectious inflammation of the conjunctiva.

In three-year-old children, inflammation of the conjunctiva and eyelids continues to prevail, but cases of hyperopia, as well as subjective visual disturbances, have already been registered in them.

Inflammation of the eyelids was most common in 2019 in four-year-olds.

In five-year-old children, the most common leading diagnosis was "Astigmatism", with cases of accommodation disorders also observed for the first time.

The data on the distribution of leading diagnoses in 6-11-year-olds for 2019 are presented in Figure 7. The prevalence of refractive errors over all other diagnoses among children in this age group is clearly visible, with inflammatory diseases and trauma occurring significantly less frequently than in the group of children up to 5 years old.

In six-year-old children, the most common leading diagnoses were “Astigmatism”, “Hypermetropia” and “Acute atopic conjunctivitis”.

In seven-year-olds, there was no significant change in the above-mentioned morbidity, with the exception of refractive errors, which were increasing.

The growth of refractive errors also continued in 8-year-old children. The most common leading diagnosis in them for 2019 was “Hypermetropia”, followed by “Myopia” and “Astigmatism”.

In 9-year-olds, refractive errors continue to be the most common, but with a predominance of astigmatism.

Myopia and hyperopia are the most common reasons for primary eye examination among 10-year-olds in 2019, with the same frequency.

In 11-year-olds, no significant change in the distribution of eye pathology is observed, except for a slight decrease in the frequency of refractive errors and an increase in the frequency of conjunctival and eyelid inflammation.

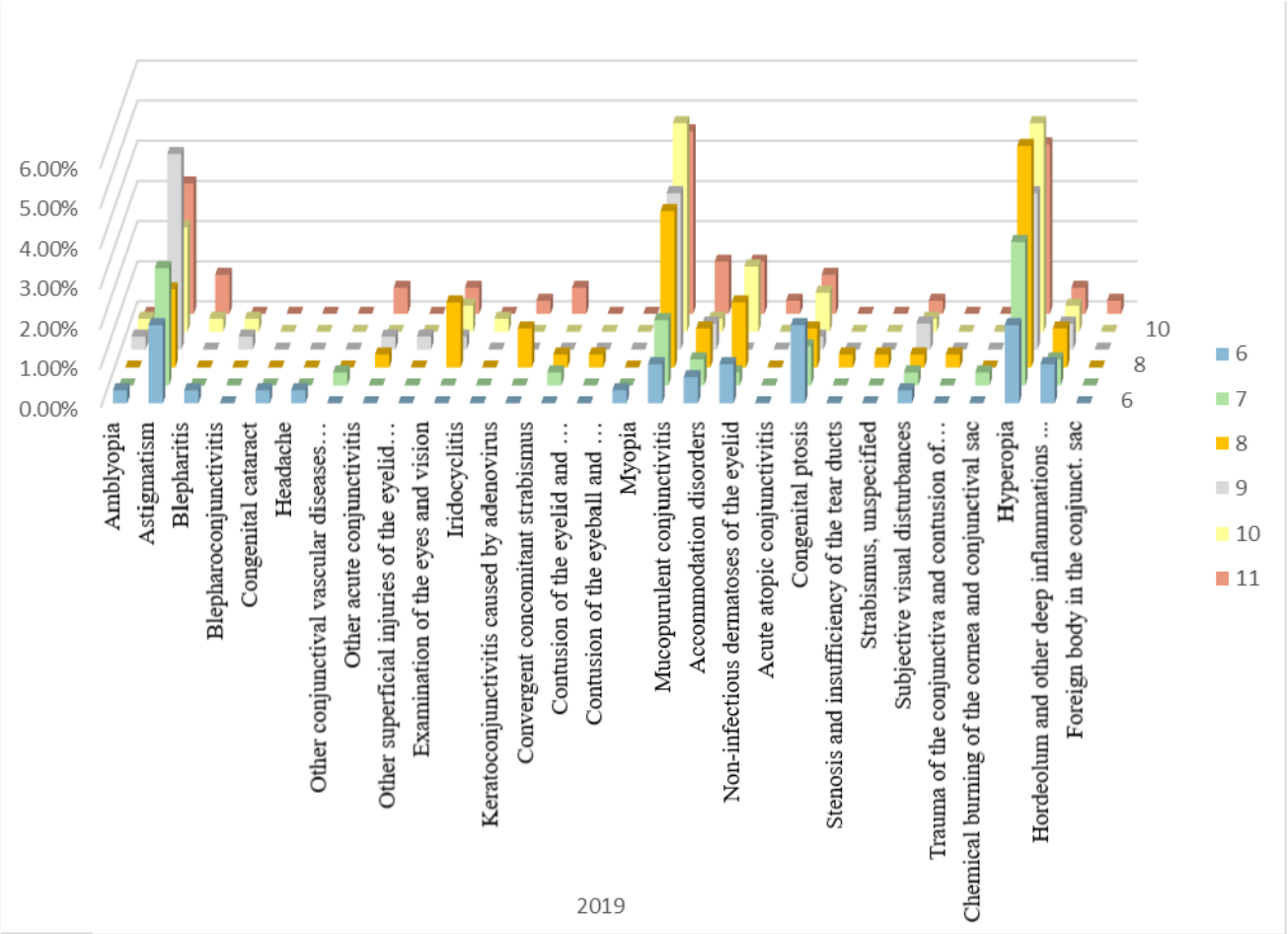

Figure 7. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 6-11 years, for 2019.

Figure 8 shows the distribution of eye pathology in children between 12 and 17 years old. for 2019. And in this group, refractive anomalies dominate over the remaining pathology in all ages.

The predominant leading diagnosis for 2019 in 12-year-old children is myopia, followed by hyperopia and strabismus.

In 13-year-olds, mostly refractive anomalies were registered, with myopia in first place in frequency, followed by astigmatism and hyperopia.

The main trend of distribution of ophthalmological pathology in the group of 12-17 years old is preserved in persons aged 14 (refractive anomalies lead, followed by infectious inflammations and trauma), but the distribution of refractive errors is different, with astigmatism overtaking myopia.

Among 15-year-olds, myopia again ranks first among the leading diagnoses, followed by astigmatism and hyperopia.

The most frequently registered leading diagnosis among 16-year-olds in 2019 is "Astigmatism", while the diagnoses "Myopia" and "Hyperopia" are less common.

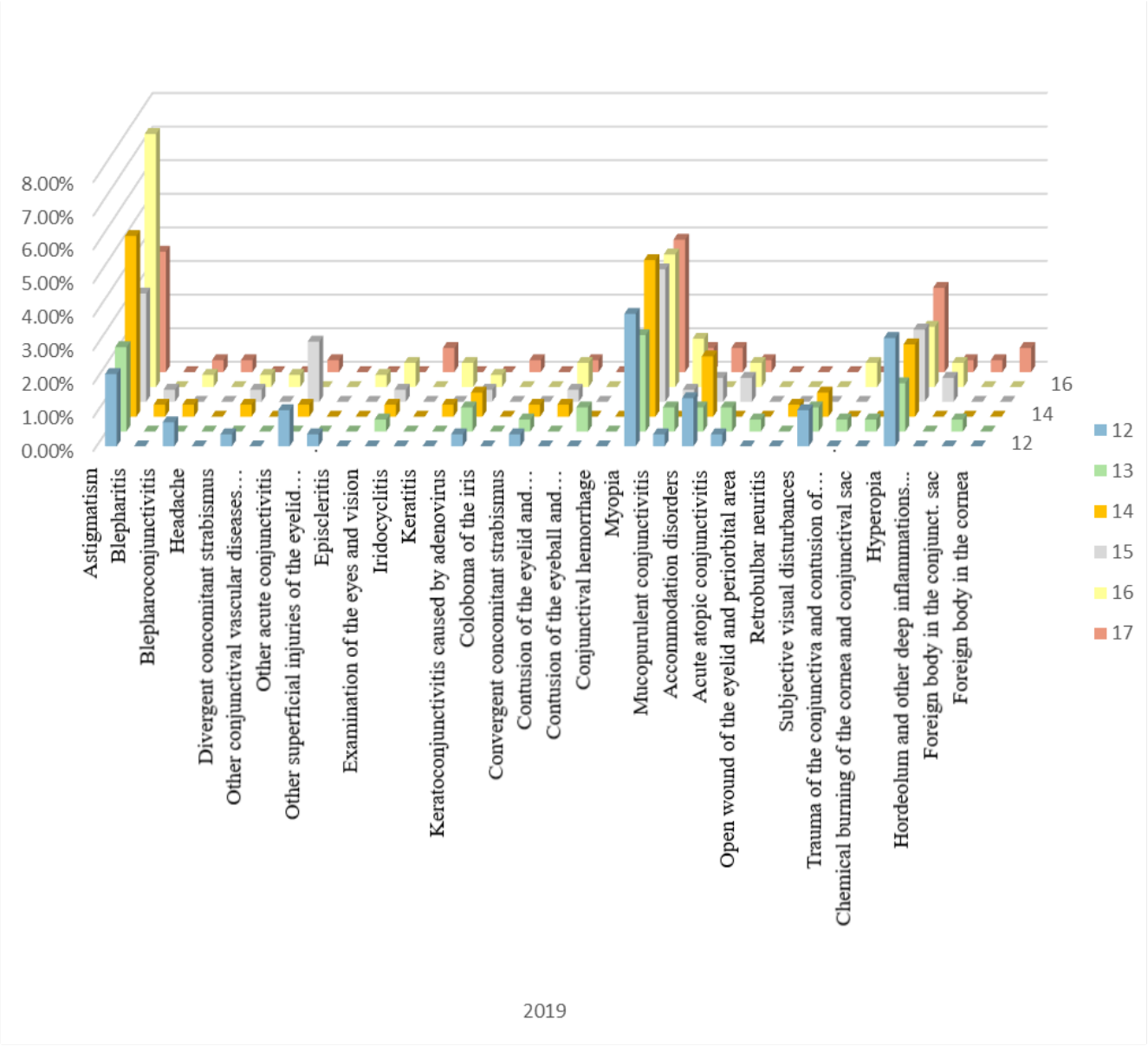

Figure 8. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 12-17 years, for 2019.

Figure 9 examines the distribution of ophthalmological pathology among children up to 5 years of age in 2020. In children under 1 year of age, significantly fewer diagnoses were registered compared to other age subgroups. The diagnosis "Stenosis and insufficiency of the lacrimal ducts" prevails, and cases of "Preretinopathy" (the second most frequent diagnosis among children under 1 year of age) were also registered this year.

In one-year-old children, mucopurulent conjunctivitis and hordeolum predominate, followed by the diagnosis "Examination of the eyes and vision".

In 2-year-olds in 2020, conjunctival inflammations also predominate (mucopurulent and atopic conjunctivitis occur equally frequently), as well as the diagnosis "Hordeolum and other deep inflammations of the eyelids".

In 3-year-old children, mucopurulent conjunctivitis is the most common reason for a primary eye examination in 2020. For the entire period of the study, the diagnosis "Malignant neoplasms of the retina" was found once - in a 3-year-old child in 2020.

Hyperopia clearly predominates in 4-year-olds. In them, the diagnosis "Subjective visual disorders" also appears in the group for the first time. A clear increase in the share of refractive anomalies is noted, at the expense of eye inflammations at this age.

In five-year-olds, no significant dynamics are observed in the leading diagnoses compared to four-year-olds, with the exception of a decrease in cases of hyperopia.

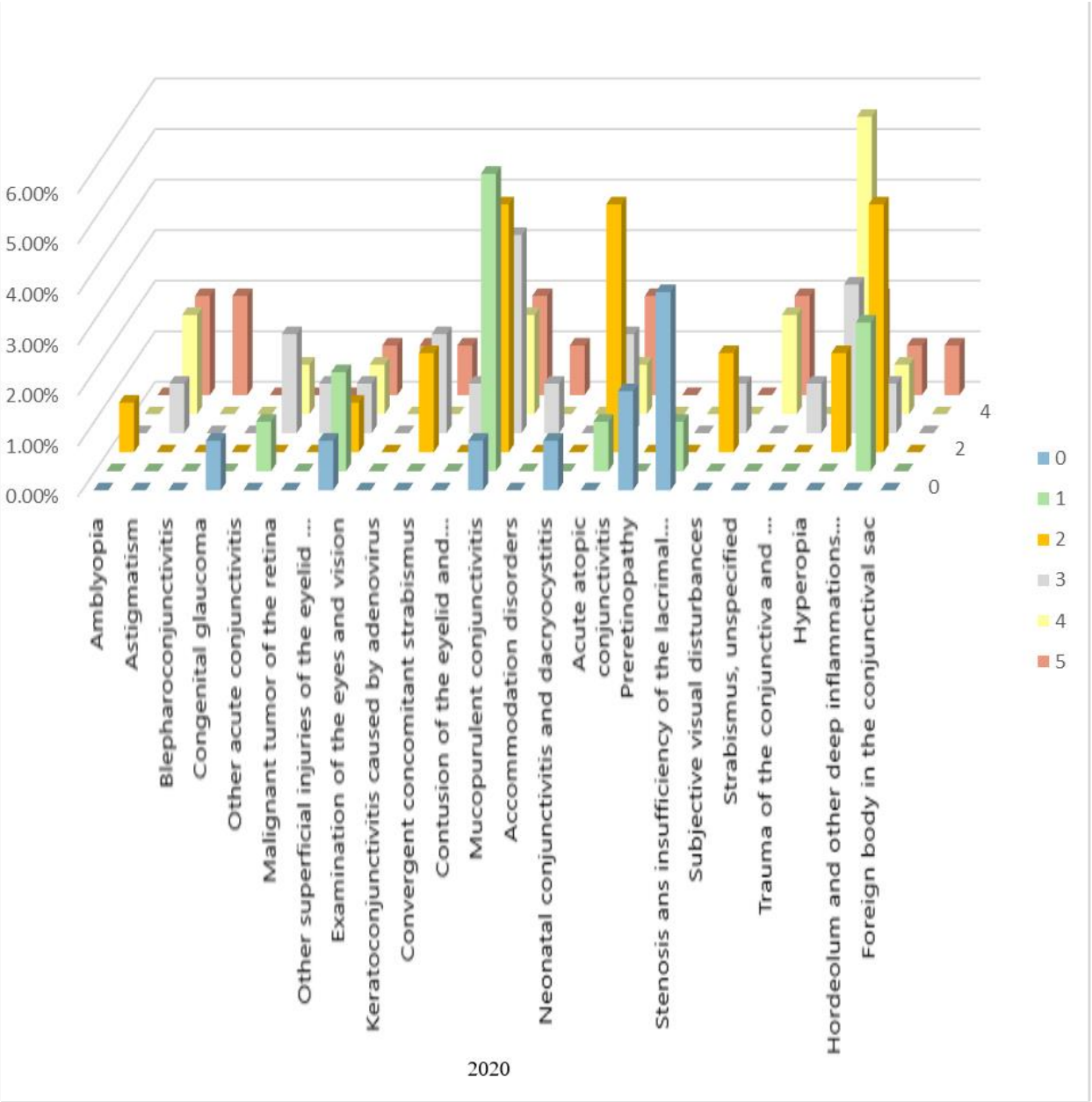

Figure 9. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 0-5 years, for 2020.

Figure 10 presents the distribution of eye pathology among children aged 6-11 in 2020. In six-year-olds, hyperopia and astigmatism clearly prevail over the other leading diagnoses, but not a single case of myopia was registered.

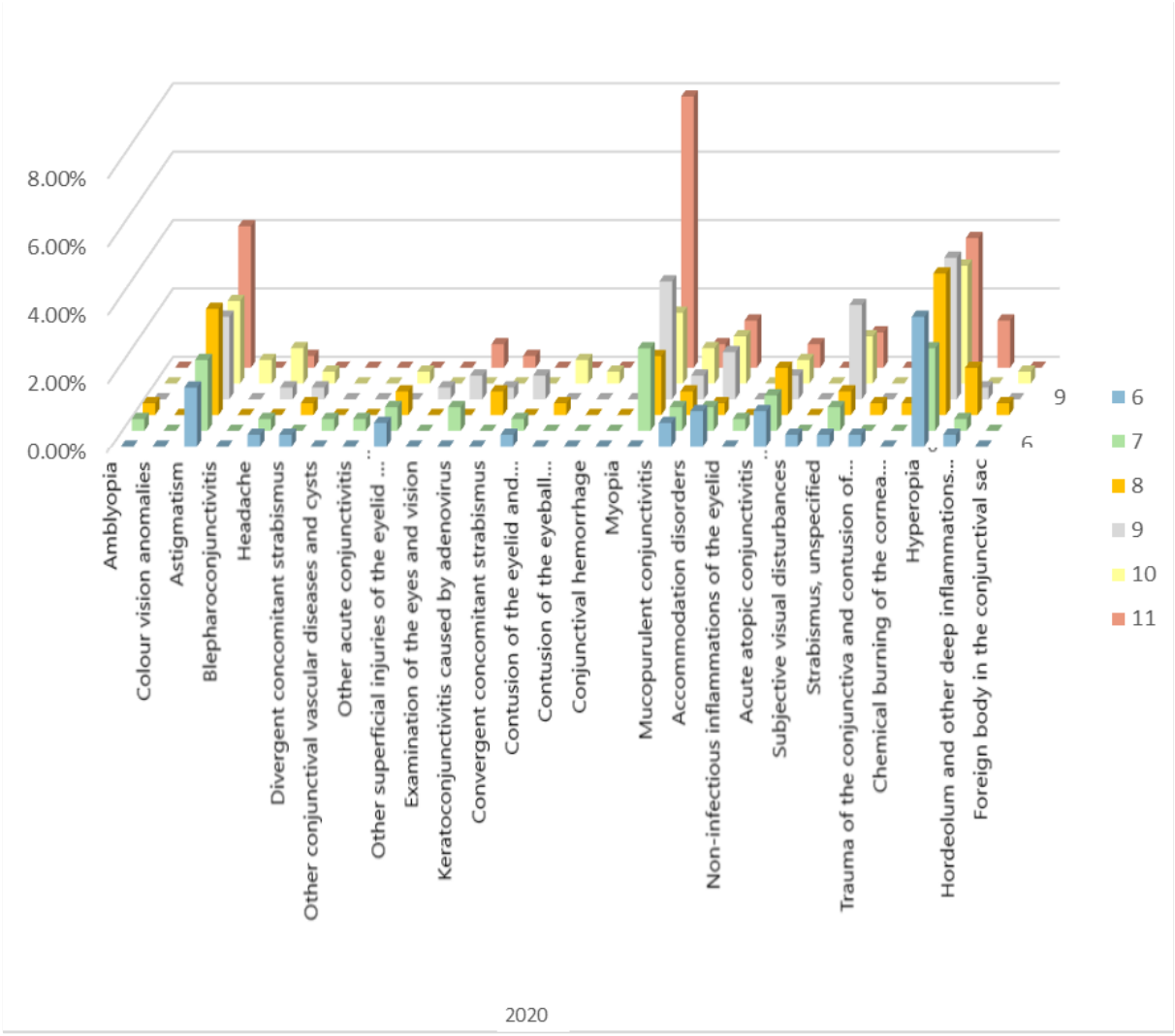

Figure 10. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 6-11 years, for 2020.

Seven-year-old children visited an eye doctor in 2020 mainly due to various refractive anomalies, with myopia occurring at this age with a frequency close to that of hyperopia and astigmatism. No significant dynamics of the other leading diagnoses were found compared to 6-year-olds, but in 7-year-olds there were registered cases of amblyopia, as well as cases of prophylactic eye examination.

In 8-year-olds, the leading eye pathology did not differ significantly, but a slight increase in traumatic injuries was noted compared to the previous age subgroup.

In nine-year-olds, an increase in the cases of myopia and "Subjective visual disorders" is noted, with no significant changes in the frequency of the remaining diseases compared to eight-year-olds.

As for the distribution of eye pathology among 10-year-old children in 2020, refractive anomalies continue to be the leading ones in frequency, but a slight decrease in the cases of myopia is noted, compared to those reported in 9-year-old children.

In 11-year-olds, cases of refractive anomalies are rising sharply, with the most leading diagnoses being "Myopia" and "Astigmatism" in this age subgroup.

Figure 11 presents ophthalmological pathology among children aged 12-17 in 2020 in the city of Shumen. In 12-year-olds, as in all age subgroups, refractive anomalies significantly prevail over other eye diseases. Myopia and hyperopia occur equally often, and astigmatism occurs less often.

In 13-year-olds, a decrease in the frequency of myopia and hyperopia is observed, compared to 12-year-olds, while astigmatism remains at the same levels. The diagnosis of "Amblyopia" is also registered, and traumatic injuries are also encountered.

In 14-year-olds, the distribution of eye pathology is close to that in 13-year-olds, except for the twice higher frequency of myopia.

Myopia and astigmatism are most common in 15-year-olds, with the diagnosis "Accommodation Disorders" in third place in prevalence and ahead of hyperopia. For the first time in the 12-17 age group, "Keratitis" and "Adenovirus-induced Keratoconjunctivitis" were registered in 15-year-olds.

In 16-year-olds, the distribution of eye pathology does not show significant differences compared to the previous age subgroup, except that prophylactic eye examinations were registered in 16-year-olds.

Astigmatism is the most common leading diagnosis in 17-year-olds in 2020, followed by myopia. Only in this age group is the diagnosis "Episcleritis" found.

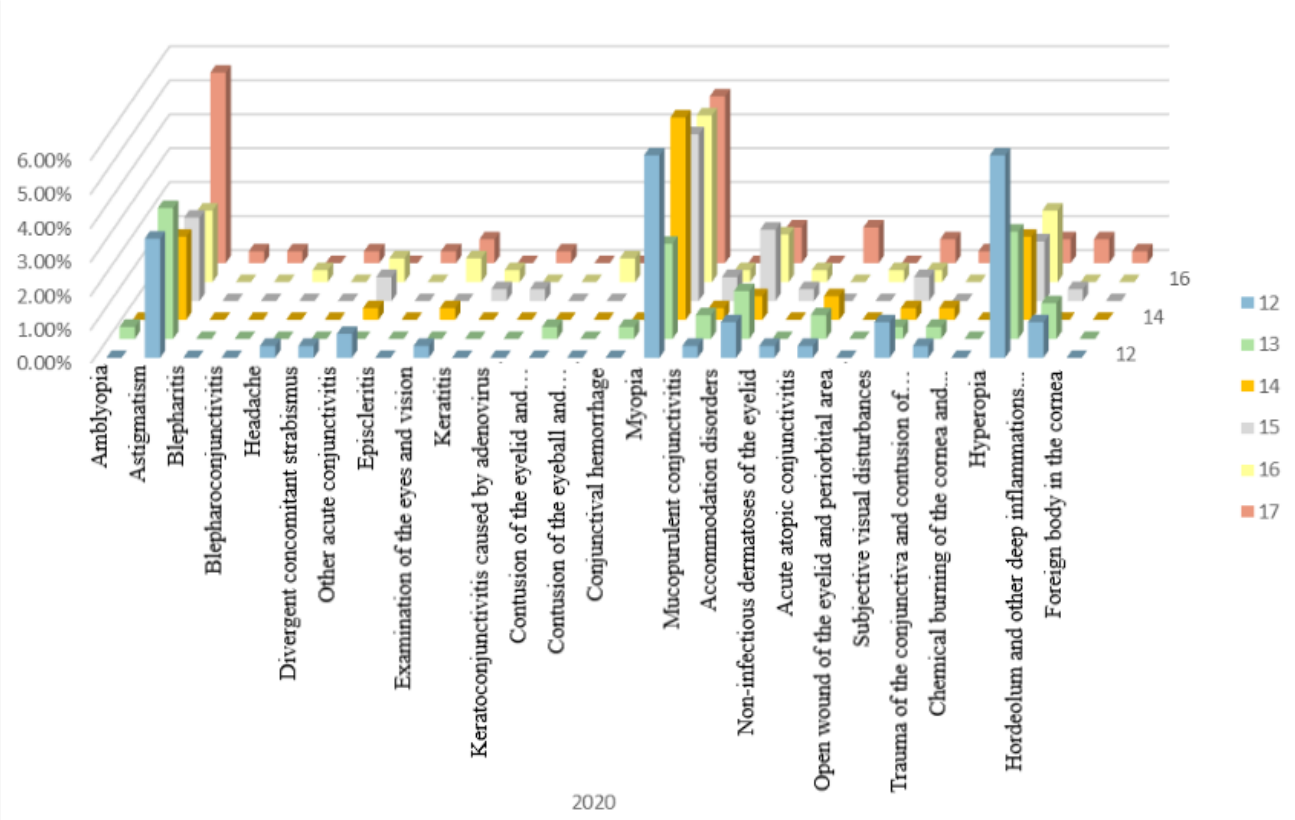

Figure 11. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 12-17 years, for 2020.

The distribution of leading diagnoses from outpatient ophthalmological examinations of children up to 5 years old in 2021 is presented in Figure 12. In children under 1 year old, only five leading diagnoses were registered in 2021. The most common are “Stenosis and insufficiency of the lacrimal ducts”, as well as “Mucopurulent conjunctivitis”. The remaining diagnoses – “Eye and vision examination”, “Neonatal conjunctivitis and dacryocystitis” and “Hemangioma of the eyelid” are less common, with the same frequency.

The most common leading diagnosis in children aged 1 year old in 2021 is “Mucopurulent conjunctivitis”, followed by the diagnosis “Strabismus, unspecified”.

In three-year-olds, no particular dynamics in eye morbidity was recorded compared to the previous age subgroup, but in children aged 3 years old the diagnoses "Accommodation disorders" and "Subjective visual disorders" are also found.

The distribution of eye pathology in children aged 4 remains almost unchanged, with the exception of the increase in the frequency of atopic conjunctivitis.

The diagnosis "Astigmatism" is most common in children aged 5 in 2021, occurring only in them in the 0-5 age group. Only in 5-year-olds there is a case of headache.

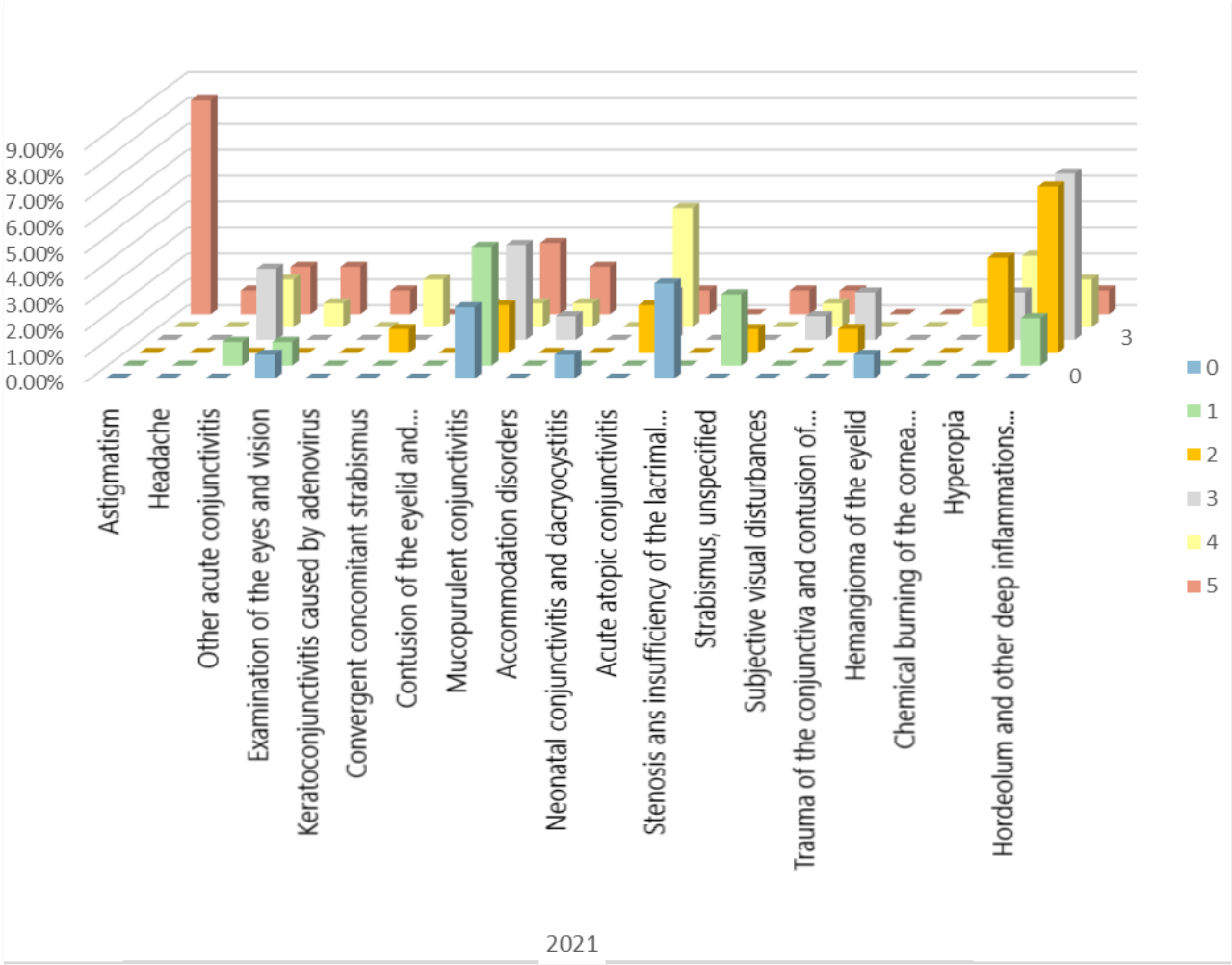

Figure 12. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 0-5 years, for 2021.

Figure 13 presents the distribution of leading diagnoses from outpatient ophthalmological examinations in children aged 6-11 years in 2021, in the medical practices included in the study on the territory of the city of Shumen.

In children aged 6 years, myopia, hyperopia and hordeolum were the most common reasons for a primary eye examination in 2021.

In seven-year-old children, refractive errors are the most common, with an increase in astigmatism and hyperopia compared to the levels in 6-year-olds, while myopia remains at the same frequency.

With the exception of the increase in the frequency of myopia and the presence of preventive eye examinations, eye pathology does not differ significantly in 8-year-old children compared to 7-year-olds.

In children aged 9 years refractive anomalies continue to be the leading ones, with a slight increase in hyperopia compared to the previous age subgroup, but without significant dynamics in the remaining eye pathology.

While in ten-year-old children the distribution of eye diseases is very close to that in the previous age subgroup, in 11-year-olds there is a jump in the frequency of refractive anomalies (especially myopia) and accommodation disorders.

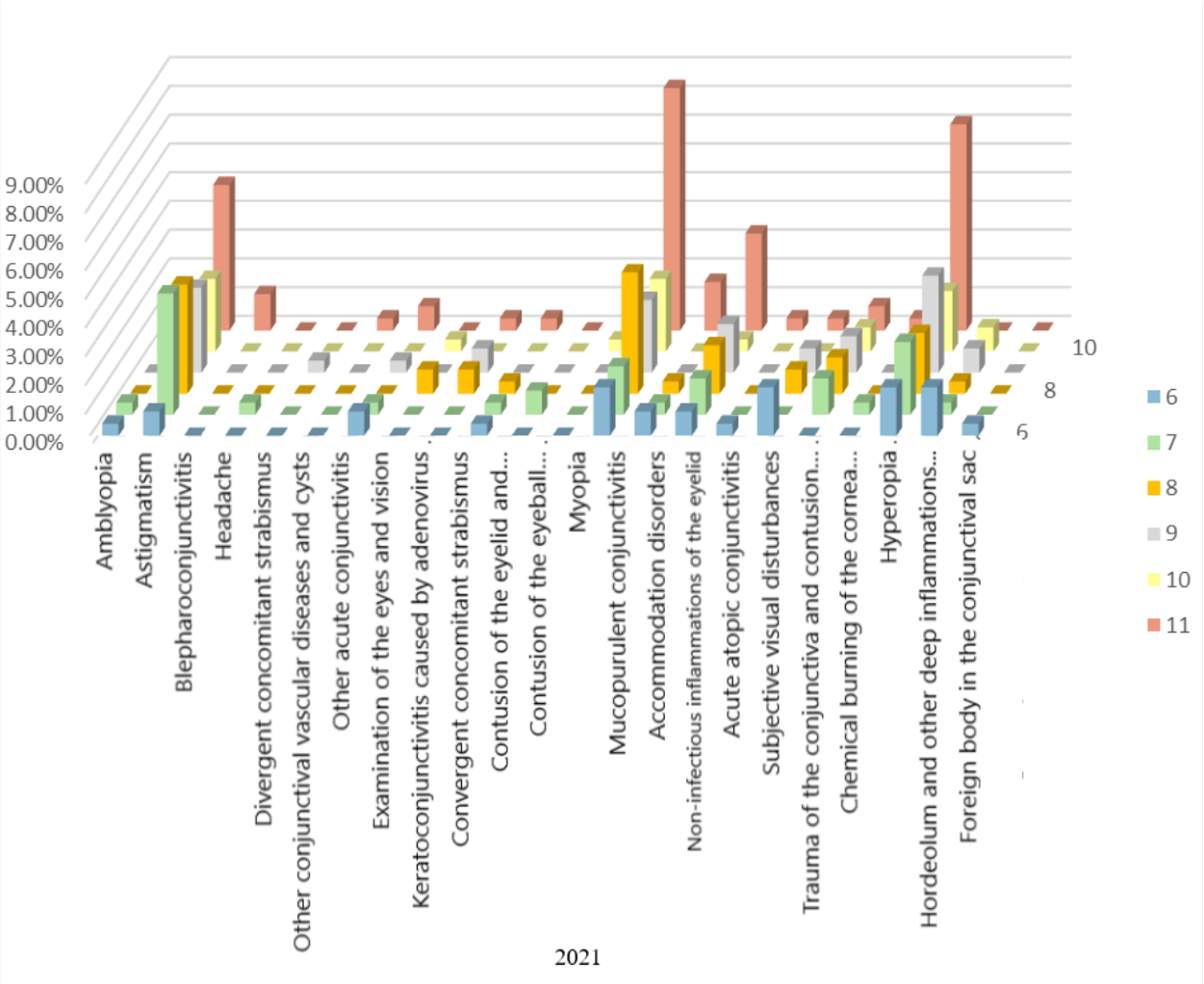

Figure 13. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 6-11 years, for 2021.

Figure 14 presents the distribution of the leading diagnoses among children aged 12-17 for 2021 in the city of Shumen. In 12-year-olds, refractive errors are the most common, with myopia prevailing, and astigmatism and hyperopia occurring equally frequently.

In 13-year-olds, the distribution of eye pathology remains unchanged compared to 12-year-olds, but cases of headache, preventive examination and atopic conjunctivitis have also been registered.

In 14-year-olds, cases of myopia have increased compared to the previous age subgroup, and only in them was a case of optic nerve atrophy registered.

The most common leading diagnoses among 15-year-olds in 2021 were "Astigmatism" and "Myopia", followed by "Hyperopia" and "Accommodation disorders".

As for 16-year-olds, in 2021. the most common reason for a primary eye examination among them was myopia.

For 17-year-olds, the diagnosis "Myopia" was the most common in 2021. It was followed by "Astigmatism", "Hyperopia" and "Headache. A slight increase in the frequency of traumatic injuries was noted, compared to the previous age subgroups.

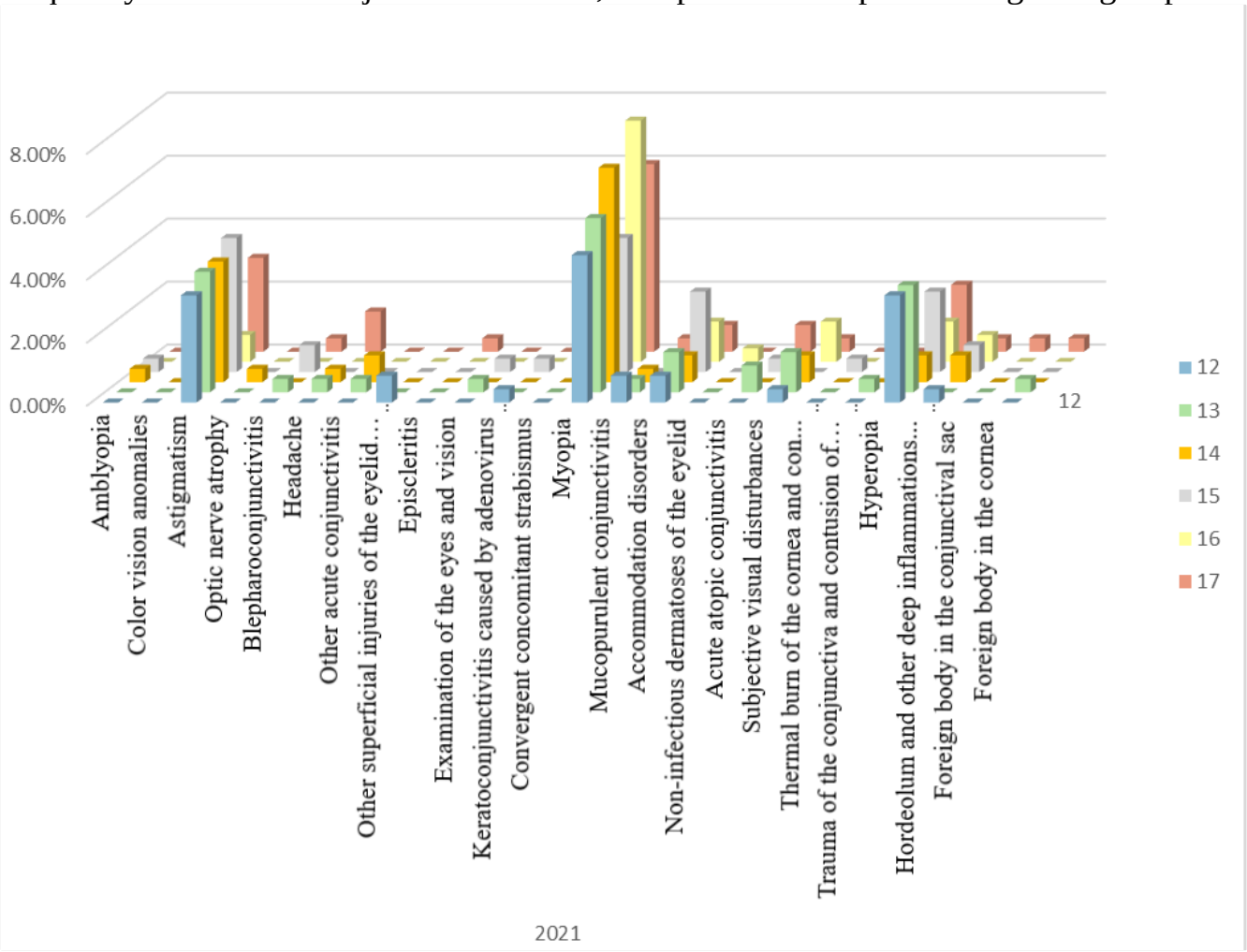

Figure 14. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 12-17 years, for 2021.

The frequency of the various leading diagnoses in children under 5 years of age in 2022, in the pre-hospital care centers covered by the study, is presented in Figure 15. In children under 1 year of age, the predominant diagnosis is “Stenosis and insufficiency of the lacrimal ducts”, followed by “Mucopurulent conjunctivitis” and “Hordeolum and other deep inflammations of the eyelid” (second and third in frequency, respectively). “

In children aged 1 year, inflammatory diseases are leading, with the diagnosis “Mucopurulent conjunctivitis” at the top, followed by “Hordeolum and other deep inflammations of the eyelid”.

In 2-year-old children, the most common diagnosis in 2022 is “Hordeolum and other deep inflammations of the eyelid”. "

In three-year-old children, the distribution of eye pathology is different, with allergic conjunctivitis, corneal and conjunctival injuries, and hordeolum being the most common.

The diagnosis "Acute atopic conjunctivitis" is also the most common in 4-year-old children. Only in 4-year-olds in the 0-5 group was the diagnosis "Examination of the eyes and vision" not registered.

As for 5-year-old children, the diagnoses "Astigmatism" and "Acute atopic conjunctivitis" were the most common in 2022, occurring equally often.

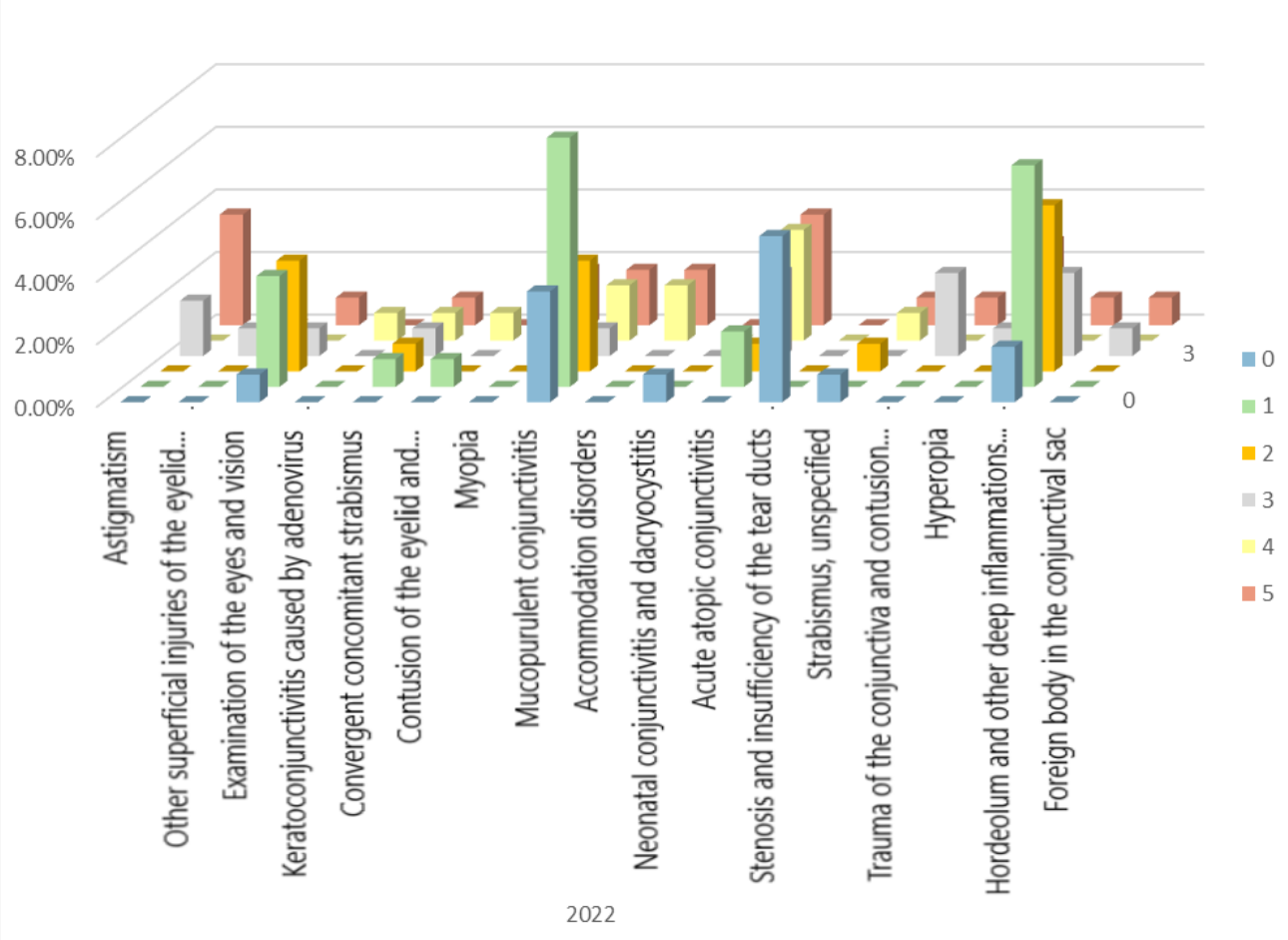

Figure 15. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 0-5 years, for 2022.

The distribution of the eye population among children in the 6-11 age group for 2022 is presented in Figure 16. Among 7-year-olds, the most common in 2022 are refractive anomalies, with astigmatism, myopia and hyperopia occurring equally frequently.

Among 8-year-olds, myopia, hyperopia and subjective visual disorders occupy the first, second and third place in terms of prevalence, respectively, and astigmatism ranks after them.

Refractive errors are the most common reason for a primary eye examination in 9-year-olds in 2022, with myopia leading, followed by hyperopia and astigmatism with equal frequency

In 10-year-olds, refractive errors are again in first place in frequency, but with a different distribution - hyperopia and astigmatism are in first place, as they occur equally often, followed by myopia.

Myopia is by far the most common diagnosis among all the leading diagnoses in 11-year-olds, followed by hyperopia and accommodation disorders. Astigmatism is only in fourth place in frequency.

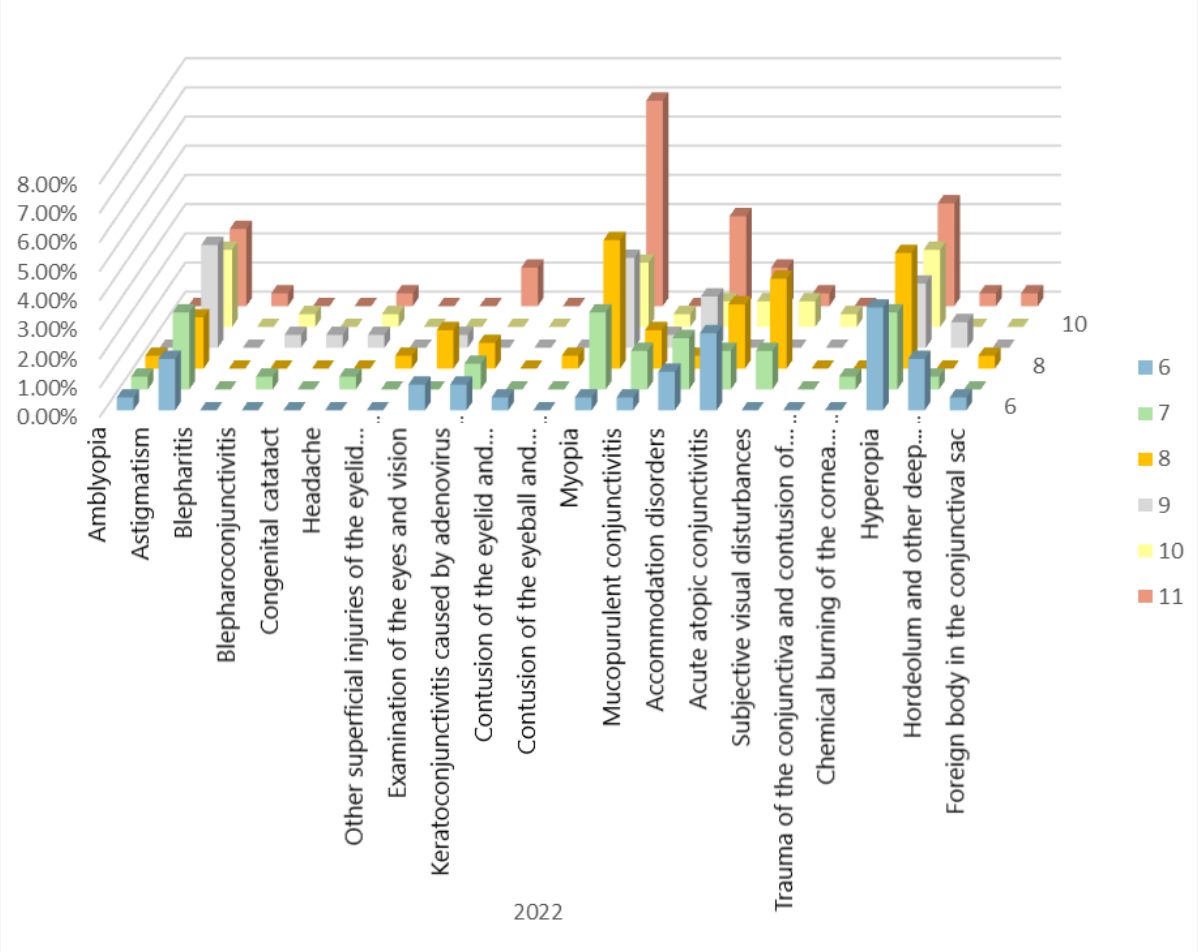

Figure 16. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 6-11 years, for 2022.

Figure 17 presents the frequency of the various leading diagnoses in 12-17 year olds in 2022.

In each of the age subgroups, refractive errors predominate, while the remaining ocular pathology is less common.

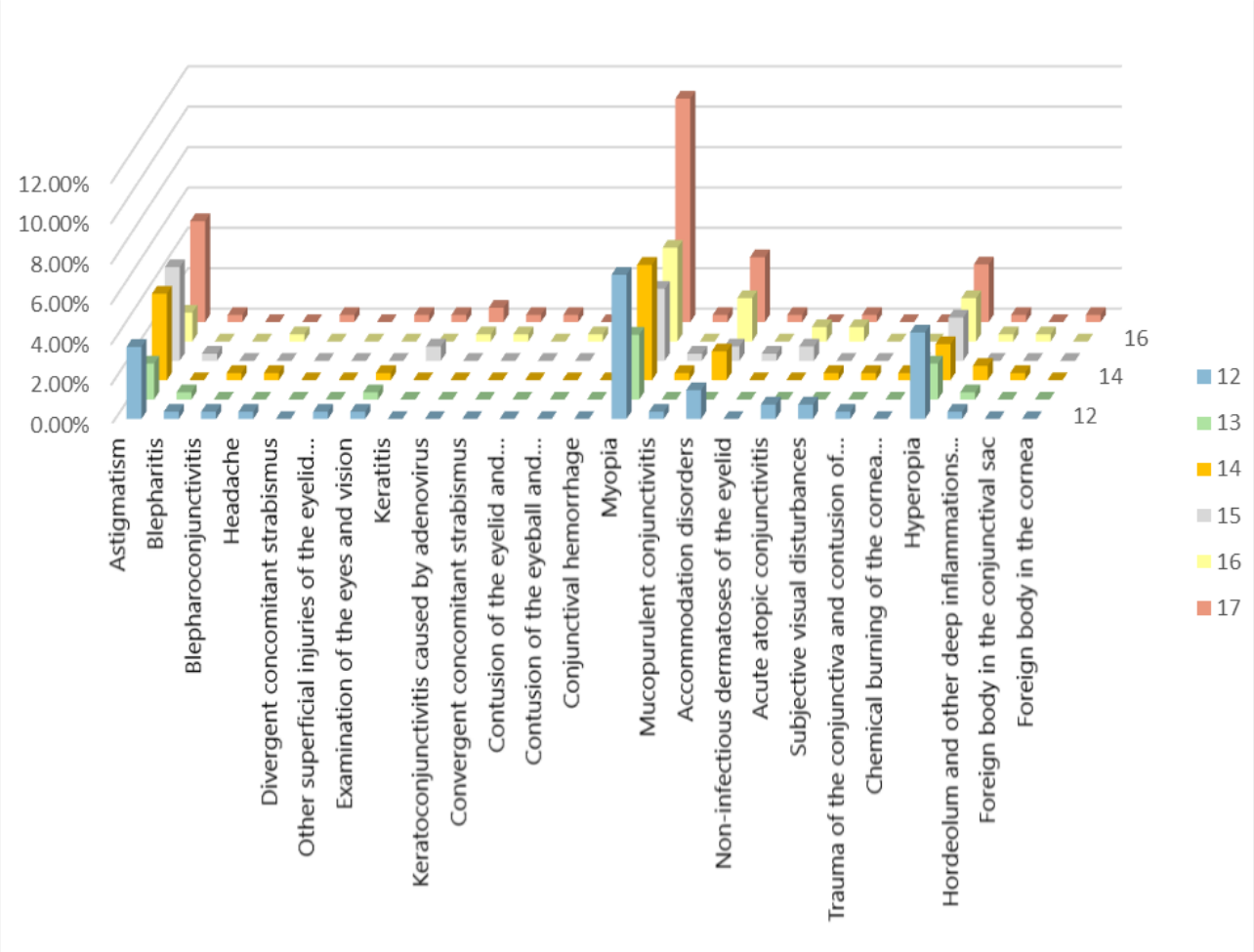

Figure 17. Distribution of leading diagnoses from primary ophthalmological examinations in the age group 12-17 years, for 2022.

5. DISCUSSION

When analyzing the results of the study, it should be taken into account that the information was extracted from documentation from outpatient ophthalmological examinations, and not from preventive ones. The clarification is important, as it reflects the state of a population that sought qualified medical care due to the presence of complaints of ocular origin or was referred for a specialized eye examination by a general practitioner after pathology was identified. Many eye diseases remain undiagnosed until late in life, as children often do not realize that they have a vision problem or fail to clearly articulate it to their parents. This is especially true for refractive errors, which often have no external manifestation and, in the absence of strabismus or other accompanying complaints, can remain unrecognized for a long time. This poses a risk of developing amblyopia and/or problems in communication, education and future professional development. It is assumed that a screening program

conducted on-site in schools and kindergartens would establish a different frequency and ratio between the different types of ophthalmological pathology among children.

The results obtained show that the largest number of primary eye examinations in childhood were performed at the beginning of the study period (697), with a decrease in visits in 2020 and 2021 (respectively 679 and 581 primary eye examinations). It is possible that the dynamics in the frequency of primary ophthalmological examinations in childhood were influenced by the onset of the COVID-19 pandemic in early 2020. The imposed anti-epidemic measures, including limiting leaving the home and suspending preventive examinations, as well as the fear of infection when visiting a health facility, significantly reduced the number of pediatric eye examinations in the pandemic period (2020 - 2021). In 2022 There was again an increase in eye examinations for persons up to 17 years of age (622), but without reaching the values of 2019.

As for the distribution by gender, an eye examination was performed more often in girls than in boys, without a statistically significant difference in the number of examinations.

It is striking that the least number of registered primary eye examinations were in the age group from 0 to 5 years. This may be due to the inability of young children to realize and articulate their vision problem. Therefore, at this age, a large part of eye pathology without obvious symptoms remains undiagnosed and, accordingly, untimely treated. Unfortunately, the lack of a regulated program for children's eye screening at the national level, as well as the insufficient awareness of parents about the importance of eye health prophylaxis, leads to a low frequency of ophthalmological examinations in this sensitive age for the development of vision. When interpreting the results, it should also be taken into account that the health facilities included in the study provide outpatient medical care. Ophthalmological examinations of newborns with obvious eye pathology immediately after birth, as well as of premature infants at risk of developing ROP, are performed on site - in the neonatology department of Multi-progile hospital for active treatment- Shumen. In the presence of a serious ophthalmological problem and the need for additional surgical or laser interventions (congenital glaucoma, congenital cataract, ROP), a large part of the children are referred for treatment to specialized eye hospitals in other regional cities, due to the lack of the necessary conditions, equipment and narrow specialists in the field of pediatric ophthalmology. Very often, after treatment, children continue to be monitored by their treating physician in another locality, which affects the frequency of eye examinations in this age group, on the territory of the city of Shumen.

The frequency of primary eye examinations increases significantly in the age groups from 6 to 11 years (1070) and from 12 to 17 years (1082). This is largely due to the fact that children over 6 years of age can much more clearly realize and articulate their complaints of ocular origin. Upon entering preschool and early school age (6-11 years) a significant change occurs in children's daily lives. The educational process at school includes a long time spent in close work (reading, writing, working with a

screen), but also working with text and symbols at a long distance (the school board, projected images from multimedia, etc.). Prolonged close work can often provoke asthenopic complaints and accommodative disorders, especially in children with uncorrected refractive errors. At this age school myopia, causes inability of children to read clearly what is written on the school board and often becomes a reason for the first eye examination.

In teenagers (12-17 years old), the frequency of primary examinations for the studied period is the highest, but it approaches that of the previous age group. It should be borne in mind that part of the examinations in older children are related to eye pathology diagnosed at an earlier age and periodic control by the treating ophthalmologist.

As for the distribution of eye pathology among the pediatric population for the entire four-year study period, it becomes clear that the most common reason for a primary eye examination is refractive anomalies (54.31%). These data are consistent with the results obtained from studies on medical records from other countries, such as India (54.62%) [223] and China (41.2%) [254], Sudan [233] and Nepal [224], as well as with the indigenous population of Australia (18.1%) [234]. Studies conducted in Europe on pediatric eye health have focused mainly on refractive errors, and data on the overall distribution of ophthalmological pathology in the pediatric population are scarce. Therefore, it is difficult to make a comparison between the frequency of refractive errors in these countries and in Bulgaria.

Data on pediatric eye morbidity from Bulgaria are collected mainly from eye screening programs conducted in a certain age group and targeting specific diseases. Therefore, there is no full comparability with the data from the present study, since in screening programs a large part of the examined individuals are without registered pathology, which also affects the percentage distribution of eye diseases. However, it should be noted that the results of all the reviewed screening programs also indicate a predominance of refractive errors over other ocular pathologies in childhood. [240-242] According to this indicator, the studied pediatric population in the city of Shumen follows a trend in the distribution of pediatric ocular pathologies in Bulgaria.

Of interest is the second most common group of diseases – “Asthenopia, headache and accommodative disorders” (11.18%). It is ahead of the group of infectious conjunctivitis (10.16%), outlining a specific picture of ocular morbidity among children in the city of Shumen.

A study among students in Brazil aged 6-16 also found a high percentage of children showing symptoms of asthenopia (25% of the children examined). [128] A high incidence of asthenopic complaints and accommodative disorders (70% of children studied) has also been observed in France, without any association with a specific refractive error being established. [65]

The high prevalence of diagnoses in the group “Asthenopia, headache and accommodative disorders” can be explained by the fact that the present study examined results of primary outpatient examinations with a leading diagnosis formulated

according to the ICD and specifically related to the main reason for the eye examination and the patient's leading complaint. This explains the high prevalence of diagnoses such as "Headache", "Accommodative disorders" and "Subjective visual disturbances". These diagnoses are usually not included in the results of studies on childhood eye morbidity, unless the study is focused directly on this type of pathology.

Screening examinations are usually aimed at examining visual acuity and obvious changes in the visual analyzer, and anamnestic data is not collected. This leads to a predominance of diagnoses that can be made using objective refraction testing (autorefractometry/skiascopy after cycloplegia) or through instrumental examinations (biomicroscopy, ophthalmoscopy, etc. included in the screening). The frequency of diagnoses related to subjective complaints of patients is low or completely absent. This is understandable, since eye screening programs are aimed at all children, regardless of whether they have or do not have complaints of ocular origin. Subjective complaints of young patients related to diagnoses from this group often become the reason for a first visit to an ophthalmologist and possible detection of an underlying ophthalmological problem, therefore they should not be underestimated. Many children have strong accommodation and therefore good opportunities to compensate for the "hidden diopter". During a screening examination of visual acuity, these children usually do not show deviations from the norm, especially if the examination is performed in the first half of the day, before visual fatigue has occurred. Thus, these children successfully pass the screening test and are registered as ophthalmologically healthy, although at the end of the day or during prolonged close work they experience headaches, burning eyes, blurred vision or other types of complaints related to asthenopia or accommodative disorders. Including a short survey in the screening examinations containing questions about the most common complaints related to asthenopia and accommodative disorders in children would optimize the process of early detection of visual disorders.

In third place in terms of prevalence for the period 2019-2022, is the group of infectious conjunctivitis, which makes up 10.16% of all leading diagnoses. The frequency of infectious conjunctivitis among children in the city of Shumen is far lower than that in third world countries, but nevertheless it occupies one of the leading places among ophthalmological pathologies. It should be borne in mind that conjunctivitis is among the diseases that are often managed by general practitioners. This suggests an even higher frequency of conjunctivitis in children than that reported in the study.

The group "Inflammatory diseases of the eyelids" is the fourth most common in patients up to 17 years old for the studied period (6.89%). In the literature, inflammatory diseases of the eyelids and conjunctiva are most often combined into a common group, as the frequency of eyelid pathology is not specified and there is a lack of sufficient data on its prevalence.

In fifth place in terms of prevalence are the leading diagnoses from the group of allergic eye diseases (5.53%). This group includes the diagnoses "Acute atopic conjunctivitis" and "Non-infectious dermatoses of the eyelid". According to the ICD,

the only diagnosis defining this pathology as far as the conjunctiva is concerned is "Acute atopic conjunctivitis", therefore the frequency of seasonal, year-round, vernal, atopic and giant cell conjunctivitis cannot be established in the present study. Compared to countries such as Nigeria and India, where allergic conjunctivitis is the second most common among children, in the city of Shumen it is relatively rare.

Eye trauma is the sixth most common reason for primary eye examination in childhood in the city of Shumen, during the study period (5.53%). Compared to countries such as Nigeria, where traumatic injuries rank first among eye pathologies in children [231] and Ethiopia, where they rank second in prevalence after infectious inflammations [232], the incidence of childhood eye trauma reported in the study is relatively low. In South China [226] a higher incidence of childhood trauma was also reported, compared to the present study (11.8%). When analyzing the results, it should be taken into account that the data for the present study was extracted from outpatient examinations in pre-hospital medical care units. It is assumed that the frequency of childhood eye trauma is higher than that reported in the study, since some of the patients with trauma visit emergency rooms, where, depending on the nature of the injury, they are either referred for hospitalization (in case of severe trauma and need for surgical treatment), or are managed on site by the on-call team, most often after consultation with an ophthalmologist assigned to the hospital health facility. The next most common reason for a primary eye examination in patients up to 17 years of age is a prophylactic eye examination, designated according to the ICD as "Examination of the eyes and vision". This is a diagnosis made in the absence of complaints from the patient and the absence of established ophthalmological pathology during the study. Due to the specificity of the study, it is difficult to draw a parallel between the results established in the city of Shumen and other settlements. When analyzing the results, it should be noted that according to the study methods, the leading diagnosis from the outpatient examination is taken into account. It is possible that the percentage of children who visited an ophthalmologist for a preventive examination is higher than reported in the study, since if a pathology is detected during the examination (in a patient without symptoms), it is entered in the list as the leading diagnosis.

Although a parallel cannot be drawn with data from other studies, the frequency of registered diagnoses "Examination of the eyes and vision" in different years of the study period may be indicative of the priority of children's vision prevention for society in the study period. The dynamics in the frequency of leading diagnoses during the study period will be considered at a later stage in the discussion.

Diagnoses in the “Strabismus” group were the eighth most common among children in 2019–2022 (2.41%). The data are comparable to the results of a similar study conducted in India. [222] There, the incidence of strabismus among the child population is twice as high, accounting for nearly 5% of all eye diseases. Much higher cases of strabismus were found in Ethiopia (17%) and Cameroon (22%). [148] A study in Kathmandu (Nepal) [224] also showed a high incidence of strabismus among children in the local population (third most common eye pathology), compared to the data from the present study. In China, strabismus ranks second in frequency among

registered eye pathologies in childhood (36.1%). [254] Surprising results were found in a study from Saudi Arabia, where strabismus was the most common eye pathology among the children studied (36.9%). [229]. As for the data from Bulgaria, they are closer to those reported in Shumen. The screening program "Children's Vision" conducted in Varna detected strabismus in 3.5% of the children examined in 2013. [240] A screening study conducted in Smolyan for the period 2013-2018 found a similar frequency of latent strabismus in childhood – 3.9%. [242]

Of course, in some countries the frequency of strabismus is lower than that reported in Bulgaria and Shumen. For example, in Baltimore (USA) strabismus occurs in 1.61% of children. This pathology is also rarely observed in Brazil (1.4%), Iran (1.68%), as well as in Denmark (1.36%). The lowest frequency of strabismus was reported among the pediatric population in Singapore (0.14%) and Japan (0.2%). [148]

The prevalence of strabismus during the study period is significantly lower than that reported among the pediatric population in some Asian and African countries, but higher than that recorded, for example, in the USA and Brazil. It is difficult to determine a trend in the prevalence of strabismus, since its frequency varies significantly between different countries, without any specific racial or ethnic predisposition to this pathology. The results from the city of Shumen are closer to the data from other Bulgarian cities, but the frequency of strabismus remains lower than the frequency reported in them.

The group "Other" is in ninth place in frequency. It includes diagnoses that cannot be attributed to the other groups and are rare, including congenital diseases, amblyopia, color vision abnormalities, lacrimal duct stenosis, conjunctival hemorrhage, as well as other rare but significant diseases in childhood affecting the optic nerve and retina. Since the diagnoses in this group are not united by a common characteristic, their frequency will be considered separately in the discussion.

In penultimate place are inflammations of the cornea, sclera and uvea (0.55%). Their frequency is low in the studied population, but there is a lack of sufficient literature data to allow a comparison.

The last place in frequency is occupied by the group of ocular tumors (0.24%). It includes diagnoses related to benign tumors – "Other conjunctival vascular diseases and cysts" and "Hemangioma of the eyelid", as well as the diagnosis "Malignant tumors of the retina".

The results examined show dynamics in the frequency of different groups of diagnoses during the study period. Refractive anomalies are the most common pathology in each year of the study period, maintaining relative constancy in their frequency (54.35% - 55.08%), with the remaining groups of diagnoses also not showing a significant difference in their prevalence for the study period. The groups "Accommodative disorders, headache, asthenopia", Examination of the eyes and vision", as well as "Infectious inflammations of the conjunctiva", however, show significant dynamics in their frequency.

At the beginning of the study period (2019, before the COVID-19 pandemic), infectious conjunctivitis in childhood was in second place in prevalence (12.88%),

ahead of the group “Accommodation disorders, headache, asthenopia”. During the height of the coronavirus pandemic (2020-2021), their frequency decreased significantly, respectively. by 3.15% ($p \leq 0.05$) in 2020 and by 3.06% ($p \leq 0.05$)in 2021. At the end of the study period, after the pandemic subsided, the frequency of diagnoses in the group continued to decline, and in 2022 it was 4.97% ($p \leq 0.05$) lower than in 2019.

The fact that the most common manifestation of COVID-19 infection in childhood is conjunctivitis leads to the expectation of an increase in conjunctivitis cases during the pandemic period. However, the results of the study show exactly the opposite. The progressive, statistically significant decrease in the frequency of infectious conjunctivitis in childhood during the study period can be interpreted in different ways.

On the one hand, after the onset of the coronavirus pandemic, there has been a major change in children's daily lives, modulated by the imposed anti-epidemic measures. The time spent playing outdoors has drastically decreased, and social contacts between children have also been significantly limited. These factors, combined with wearing a protective mask and regular hand disinfection, lead to a limitation of the spread of airborne infections, but also a reduction in the frequency of other types of infectious diseases, such as conjunctivitis, which is also transmitted through close contact (with an infected person or a contaminated surface).

On the other hand, the fear of infection when visiting a health facility during a pandemic may have influenced the recorded incidence of conjunctivitis in childhood. It is possible that a large part of children with complaints were treated at home, after consultation with their GP (most often remotely) and only cases that did not respond to initial treatment were examined by an ophthalmologist. It should also be taken into account that in case of infection with the COVID-19 virus and a deteriorated general condition requiring hospital treatment, cases of conjunctivitis in hospitalized patients at Shumen Hospital are diagnosed and managed on site in the children's ward of the hospital, and accordingly cannot be reflected in the statistics of the present study. The group "Accommodative disorders, headache, asthenopia" also showed significant dynamics from the beginning to the end of the study period. In 2019, it ranked third in frequency, with only 7.54% of the leading diagnoses being from this group. In 2020, an increase in their prevalence was recorded by 4.54% ($p \leq 0.05$), compared to the previous year, with the group "Accommodative disorders, headache, asthenopia" coming in second place in frequency, after refractive errors. In 2021 and 2022, the prevalence of diagnoses in the group marked an even greater increase, exceeding the result from the beginning of the study period by 5.71% ($p \leq 0.05$). Given the changes that COVID-19 and anti-epidemic measures bring to children's lives, the results obtained are not surprising. A prolonged stay at home inevitably leads to an increase in the time spent in close-range activities, including working with screen devices. Screens are an integral part of the daily life of modern children and adolescents, but their excessive use poses risks to visual function. During a pandemic, online learning brings additional hours of screen time, as asthenopia, dry eye syndrome and accommodation

spasm are common disorders in children. This is confirmed by the results of the study and the progressive, statistically significant increase in the frequency of diagnoses in the group "Accommodative disorders, headache, asthenopia" from the beginning to the end of the study period. It is impressive that in 2022. the frequency of this group of diseases remains high, despite the abolition of anti-epidemic measures, which may be a sign of a permanent change in children's habits with worsening vision hygiene.

Dynamics is also observed in the frequency of preventive examinations, with the diagnosis "Eye and vision examination" decreasing from the beginning to the end of the study period. While the frequency of preventive examinations in 2019 and 2020 (respectively 3.04% and 2.8%) did not change much, in 2021 a significant decline was observed, with this diagnosis accounting for only 1.72%($p \leq 0.05$) of all registered for the year. In 2022 a slight increase in the number of preventive examinations was observed, which did not reach the levels of previous years of study and was not statistically significant.

These results may also be related to the impact of COVID-19, as before the onset of the virus, the frequency of preventive examinations is highest. It is normal in a pandemic for visits to health facilities to be limited to the maximum and reduced to cases of emergency or severe symptoms. This excludes preventive examinations, which also explains their reduced frequency in the period 2020-2021. In 2022, there was no significant increase in the frequency of the diagnosis "Examination of the eyes and vision", which once again testifies to the difficult transition from life in a pandemic to normal everyday life. It should be noted that the percentage of preventive eye examinations was low even in 2019, the explanation for this lies both in the lack of sufficient awareness of parents about when and why it is necessary for children to undergo preventive vision examinations, and in the lack of a national program for the prevention of children's eye health, regulating these visits.

The various refractive errors, which clearly prevail over the other leading diagnoses, also underwent dynamic changes during the studied period (Table 6).

The diagnosis "Myopia" is the most common refractive anomaly among children who underwent a primary eye examination in the pre-hospital medical care centers included in the study, accounting for 21.06% of all leading diagnoses for the study period. Astigmatism and hyperopia are less common, with approximately the same frequency (respectively 16.82% and 16.43%).

For comparison, a screening program for children's eye health, conducted in the city of Varna in 2013. among children aged between 6 and 7 years, found that of the children referred for a comprehensive eye examination due to pathology identified during the screening, 49.42% had hyperopia, 24.71% had astigmatism and 6.17% had myopia, and in 40.28% of the children the specialized examination did not find any deviations from the norm. [240] At first glance, the data differ drastically from those obtained in the present study, but the younger age of the studied population in the city of Varna should be taken into account. Examining the distribution of various refractive errors among children aged 6 and 7 in the city of Shumen, we find that in children aged 6, hyperopia accounts for 22.14% of all leading diagnoses, astigmatism – 12.98%, and myopia – 6.11%. As for children aged 7, hyperopia was registered in 20% of cases,

astigmatism – in 20.67%, and myopia – in 14.67% for the entire study period (2019-2022). On average, in 6-7-year-olds for the entire study period in the city of Shumen, hyperopia makes up 21% of all leading diagnoses, astigmatism – 17.08%, and myopia – 10.68%. It is evident that the ranking by frequency of the various refractive anomalies remains the same in the results from Shumen and Varna, but in the present study hyperopia and astigmatism are registered less frequently, and myopia more frequently, compared to the Varna results. When interpreting these differences, the fact that the present study includes data from primary eye examinations of children whose parents actively sought ophthalmological help must be taken into account again, as it is likely that the real number of children with hyperopia and astigmatism (especially in the absence of symptoms) is higher than that registered in the study. The higher percentage of children with myopia in the city of Shumen may be explained by both the more frequent active specialist search for children with myopia and the inclusion of the years with the coronavirus pandemic in the study period.

A study in France, conducted in the period 2015-2018, on cycloplegic refraction of children aged 2-12 years, shows greater similarities with the results from Shumen. [65] While hyperopia and myopia are more common in the present study than in France, the differences are not large and the ratio between these two refractive anomalies remains relatively constant in both studies. Astigmatism, however, is much more common in children from Shumen, being observed almost three times more often.

When analyzing the results and comparing them with other literature sources, it should be borne in mind that the study data cover the leading diagnoses from primary eye examinations of children in health facilities for pre-hospital medical care, and not data from a screening program. The results reflect the prevalence of various types of eye pathology in children who sought medical care, having specific complaints related to the diagnosis. Children with myopia much more often have complaints (mostly of reduced vision), which can be easily formulated to the parent, especially considering that the first manifestation of myopia is usually at preschool or school age. Children diagnosed with myopia are subject to follow-up by their treating ophthalmologist. In addition, many of the children need to update the diopters of their optical correction, which also potentially increases the number of primary examinations with the leading diagnosis of “Myopia” for the studied period.

Children with astigmatism and hyperopia may also have various complaints (depending on the size of the diopter) that may be the reason for a primary eye examination, but as can be seen from the results, this happens less often than in children with myopia. Uncompensated astigmatism and hyperopia can also cause a visible deviation of the eyeball in children. In such a case, it is possible that the leading diagnosis is from the group of strabismus, and not from the group of refractive anomalies, even if they are present.

The nature of the present study and the methods used imply the identification of the main reason for the primary examination (the leading diagnosis), which is why asymptomatic cases of hyperopia and astigmatism in the studied population cannot be registered and reflected in the general statistics. To reflect the real distribution of refractive errors among children in the city of Shumen (or other settlements), additional

studies are needed, covering the maximum part of the pediatric population (regardless of the presence of symptoms) and objectively examining refraction after cycloplegia.

Although the data obtained cannot provide complete information about the total frequency of refractive errors among the studied group, but only about the symptomatic ones, the dynamics in the frequency of various refractive errors and in particular myopia during the studied period can give us an idea of the impact of the coronavirus pandemic on children's refraction.

The results of the study show a trend of increasing the frequency of myopia as a leading diagnosis in outpatient examinations from the beginning to the end of the period 2019-2022. While in 2019 and 2020 there was no significant difference in the prevalence of myopia as a leading diagnosis, in 2021 and 2022. a statistically significant increase was observed. From the beginning to the end of the study period, the incidence of myopia among the children under 17 years of age increased by 5% ($p \leqslant 0.05$).

For comparison, in Hong Kong, the incidence of myopia among children jumped from 23.5% - 24.9% in the pre-pandemic period (2015-2019) to 36.2% after the lifting of anti-epidemic measures at the end of 2021, which represents a significantly greater change in the refractive status of the population compared to the results obtained from the city of Shumen. [109]

In Chongqing, a greater increase in myopia was also registered in the studied pediatric population in 2020 (55.02%), compared to 2019 (44.62%). [110]

The results obtained correspond to the data on the dynamics of the prevalence of myopia in other parts of the world. Although they do not reach the values reported in Asian countries, due to the great differences in the cultural and educational environment (greater intensity of the educational process, greater digital workload and limited access to natural light), they follow the global trend of increasing the incidence of myopia in childhood.

Regarding the gender distribution of individuals with myopia, in the age groups up to 12 years, no significant difference in the incidence of myopia between the two sexes was reported, but in the 12-17 year olds, girls were more often diagnosed with myopia (Table 17). The established distribution of myopia by gender corresponds to data from studies conducted in China [255], Germany [237] and Poland [70], which also prove the greater predisposition of the female sex to the development of myopia.

When considering the frequency of myopia in different age groups, it increases as expected with the age of the children, with myopia being registered least often in children under 5 years of age (0.21%), more often in the group of 6-11-year-olds (14.92%) and most often in 12-17-year-olds (23.60%). Similar results were obtained in a study in Germany, where in children under 6 years of age there was no registered case of myopia. In 7-11-year-olds myopia was found in 5.5%, and in 12-17-year-olds - in 21%. [238] When comparing, it is striking that the percentage of adolescents affected by myopia in Germany and the city of Shumen is close, but in the group 6 -

11 years. Myopia is much less common in children from Germany, which indicates an earlier age of onset of myopia in our country.

The diagnoses in the group "Accommodative disorders, headache, asthenopia", which are the second most common group of diseases among children under 17 in the city of Shumen for the studied period, also show characteristic dynamics.

The frequency of the diagnosis "Headache" increases progressively from 0.29% in 2019, to 0.88% in 2020, 1.20% in 2021 and 1.13% in 2022 (Table 10), with its prevalence increasing with the age of the children studied. It is most common in adolescents, as well as in males (Table 18). This diagnosis is rare in the studied population (on average in 0.86% of all cases). It is noteworthy, however, that the frequency of headaches increased almost threefold during the COVID-crisis, compared to the period before it, which could be explained by the change in lifestyle during this period. It should be borne in mind that headaches can be a sign of various pathologies outside the visual system, which is why this diagnosis cannot be directly related to visual strain and asthenopia, although the dynamics of its spread point to such conclusions. Accommodation disorders dominate the other diagnoses in the group, in each year of the studied period, and also increase progressively in frequency. In 2019, they accounted for 4.93% of all leading diagnoses, in 2020 – 6.19%, in 2021 – 7.57%, and in 2022 – 8.06%. Accommodation disorders are rare in children under 5 years old, but in the group 6-11 years old. and 12-17 years. their frequency increases sharply (Table 18). With the exception of the 0-5 year group, accommodative disorders were registered more often in girls. As with headaches, in the pre-COVID-19 period, accommodation disorders were less common, and they increased at the height of the pandemic, which continued even after the lifting of anti-epidemic measures. The difference in the frequency of the diagnosis "Accommodative disorders" from the beginning to the end of the study period was 3.13% ($p \leq 0.05$). This dynamics can be explained by the long hours of close work related to staying at home and online education introduced during the pandemic period, but the fact that the frequency of this diagnosis continues to grow even after the lifting of anti-epidemic measures indicates a permanent and progressive deterioration of vision hygiene in children and adolescents.

The diagnosis of 'Subjective visual disturbances' is the second most common in the group and exhibits a different dynamic from the beginning to the end of the study period. While in 2019 it accounted for 2.32% of all leading diagnoses, in 2020 there was a significant increase – 5.01%, ($p \leq 0.05$) and a gradual decrease in frequency in 2021 and 2022 (respectively 4.48% and 3.06%). Children aged 6 to 11 were most often diagnosed, followed by adolescents and children up to 5 years of age. It is evident that the prevalence of the diagnosis "Subjective visual disturbances" is highest in the period 2020-2021, after which a decline in cases is observed, which once again outlines the impact of the COVID-19 pandemic on children's eye health.

Infectious conjunctivitis, in turn, occurs most often at the beginning of the study period – 12.88% in 2019 (Table 2). In 2020 and 2021, their frequency is lower and approximately the same (9.73% and 9.82%, respectively), and in 2022, they were registered in only 7.91%, with the difference from the beginning to the end of the study period being 4.97% ($p \leq 0.05$). This trend can be explained by the change in lifestyle during the coronavirus pandemic, as social isolation and the use of personal protective equipment (masks and hand disinfection) leads to limiting the spread of both airborne infections and infectious conjunctivitis, which is transmitted through close direct contact with an infected person or contaminated surfaces. On the other hand, since conjunctivitis is the most common symptom of COVID-19 in childhood, we should expect an increase in these diagnoses during the pandemic. The lack of such a diagnosis could be explained by the fact that other symptoms are often present with coronavirus infection, quarantine of the infected is required, and often hospitalization, and these cases cannot be covered by the study.

Infectious conjunctivitis occurs most often in children in the 0-5 year group (accounting for 45.22% of all registered cases of this pathology) and its frequency decreases with age, with the 6-11 year group accounting for 31.81%, and 12-17 year olds – 22.99% (Table 13). In children up to 12 years old, infectious conjunctivitis is registered more often in boys, and in 12-17 year olds – in girls.

The higher incidence of infectious conjunctivitis in the youngest children is expected, since children up to 5 years of age usually spend their day in a nursery or kindergarten, in close contact with many other children of their same age. The lack of established hygiene habits and close contact between children make them prone to infection with bacteria and viruses. Conjunctival inflammation and secretion provoke frequent touching of the eyes and rubbing of the eyelids, which helps to quickly spread the infection in the group.

Mucopurulent conjunctivitis is most common in all age groups, but prevails in children from 0 to 5 years, almost twice as often in males (Table 13). Its prevalence is higher at the beginning of the studied period (7.39%), in 2020 and 2021. recorded a decline (5.9% and 5.34%, respectively) and a slight increase in 2022 (5.65%), and this trend can be explained by the general decrease in infectious diseases after the introduction of anti-epidemic measures during the COVID-19 crisis. The same trend was recorded for the other diagnoses in the group (Table 2).

As for the diagnosis "Neonatal conjunctivitis and dacryocystitis", it accounts for 0.19% of all diagnoses for the studied period, with no significant dynamics in its prevalence observed in different years. This frequency is close to that registered in the USA – 0.1% - 0.2% and much lower than that in developing countries, such as India – 33%. [11] It should be borne in mind that it is possible that the frequency of neonatal conjunctivitis among children in the city of Shumen is higher than reported in the study, since this type of infection occurs soon after birth and is most often managed on site, in a neonatal ward, and these cases remain beyond the scope of this study.

Inflammatory diseases of the eyelids are the next most common among children up to 17 years of age for the period 2019 – 2022. Interesting dynamics are also observed

in them (Table 3). The diagnosis "Hordeolum and other deep inflammations of the eyelid" prevails over the other diagnoses in the group, at all ages and in each year of the study period. In 2019, it made up 4.35% of all leading diagnoses, followed by a slight increase in 2020 (4.57%) and in 2021 reached 6.37%, which is the maximum frequency for the study period. In 2022, a slight decrease in the frequency of this diagnosis was again recorded (5.48%). This dynamics can partly be explained by the increase in screen time and close work in children's daily lives during the coronavirus pandemic. Visual fatigue and accommodative tension (especially in uncompensated refractive anomaly), combined with frequent eye rubbing, are the main predisposing factors for the development of this type of eyelid inflammation. The difference in the frequency of the diagnosis "Hordeolum and other deep inflammations of the eyelid" between different years in the study period, however, is small and not statistically significant, due to the impact of the COVID-19 pandemic on the spread of this pathology cannot be proven.

As for the distribution by gender, the diagnosis "Hordeolum and other deep inflammations of the eyelid" occurs with approximately the same frequency in children under 5 years of age, while in older children girls are more affected. This trend is probably due to the use of various inappropriate cosmetics and makeup in adolescent girls, combined with incorrect and incomplete cleaning of the eyelids at the end of the day.

Blepharoconjunctivitis is observed less frequently among children under 17 years of age in the city of Shumen (1.13% of all leading diagnoses, Table 3). The dynamics of its prevalence over the years in the study period is similar to that of "Hordeolum and other deep inflammations of the eyelids" (slight increase in registered cases for the period 2020 - 2021), but even for this diagnosis the difference in prevalence over the years is not statistically significant.

Blepharitis is the least common diagnosis from the group of inflammatory diseases of the eyelids (0.62% of all leading diagnoses, Table 3). It has a different prevalence dynamics. It is most common in 2019 (1.16%), followed by a decline in 2020 (0.44%), and in 2021 not a single case of blepharitis in childhood was registered. In 2022 there was again an increase in the frequency of this diagnosis (0.81%). The decrease in the incidence of blepharitis during the pandemic period is surprising, as the change in daily life after the introduction of anti-epidemic measures should rather increase the incidence and aggravate the symptoms in children with blepharitis. However, this trend was not observed.

The next most common group of diseases in the population covered by the study is that of allergic eye diseases. The diagnosis “Acute atopic conjunctivitis” is more common than “Non-infectious dermatoses of the eyelid” (respectively 5.14% and 0.39% of the leading diagnoses for the entire period, Table 5). Despite the reported dynamics in the frequency of the diagnosis “Non-infectious dermatoses of the eyelid” (with an increase in cases during the period 2020 - 2021), no statistically significant changes in the prevalence of this disease were reported during the study period. As for the dynamics in the prevalence of the diagnosis “Acute atopic conjunctivitis”, it has a similar frequency in 2019 and 2020 (respectively 4.93% and 5.16%), followed by a decline in 2021. (4.13%) and again an increase at the end of the period (6.29% in 2022).

This dynamics could be explained by the less time spent outdoors during the coronavirus pandemic and, accordingly, a decrease in exposure to environmental antigens, such as pollen and UV rays. However, the difference in the prevalence of this diagnosis in the period before, during and after the onset of COVID-19 is not statistically significant, therefore, the impact of the pandemic on the incidence of allergic conjunctivitis cannot be considered.

The group of traumatic eye injuries accounts for 3.85% of all diagnoses for the entire study period, with the prevalence dynamics showing a decrease during the pandemic period, compared to the incidence before and after it (2019 – 4.18%, 2020 – 3.39%, 2021 – 3.25%, 2022 – 4.52%, Table 9). This trend is on the one hand unexpected, since during the pandemic period the stay at home is prolonged, and according to studies, eye injuries most often occur there [161]. On the other hand, due to the less time spent playing outside, children were exposed to a lower risk of falling from a height (climbing equipment, slides, trees), being hit by a ball or a hard object (stick, stone, projectile from children's weapons) with high acceleration, and other similar injuries, with potentially serious consequences for the eye and ocular appendages. The change in the frequency of diagnoses in the group "Traumatic injuries" is not statistically significant and the influence of the pandemic period on their prevalence cannot be considered. When examining the distribution of diagnoses in the group by age and gender, we find that eye injuries were most common in children aged 12-17 years and least common in children under 5 years. (Table 21) This distribution differs from the results from Bulgaria (Sofia) [161] Ireland [154], India [158] and Nigeria [231], which found the highest increase in trauma in primary school grades. Eye injuries were least frequently registered in children under 5 years of age, and this result, although coinciding with the above-cited foreign literature sources, differs from the data from Sofia, since there a peak of eye trauma was established in 3-5-year-old children. The present study reports a predominance of cases in males in each of the age groups, and this trend is typical for pediatric eye trauma, both in Bulgaria [161] and in other countries, such as France [237] and Nigeria [231].

As for the prevalence of various traumatic injuries in the group, no significant dynamics were observed during the period 2019-2022 for any of the diagnoses. For the entire study period, contusion injuries prevailed, with the diagnoses “Conjunctival trauma and corneal contusion without foreign body” and “Contusion of the eyelid and periocular area” being the leading diagnoses in frequency (respectively 1.05% and 0.86% of all leading diagnoses for the entire study period, Table 9). These results differ from those found in France [237], where open eye injuries prevail over closed ones, but coincide with those from Bulgarian sources [162] [161]. The next most frequent diagnosis in the group is “Foreign body in the conjunctival sac”, occurring most often in teenagers and less often in other age groups (Table 21). “Other superficial injuries of the eyelid and periocular area” and “Contusion of the eyeball and periocular area” occur with approximately the same frequency, with children over 5 years of age being more affected. “Chemical burn of the cornea and conjunctival sac” is rarely observed in the studied population (up to 2 cases per year or 0.27% of all leading diagnoses for the period), occurring only in persons under 12 years of age. Only two cases of open

wound of the eyelid and periocular area were registered for the period (one in 2019 and one in 2020), both in male teenagers. The diagnosis “Thermal burn of the cornea and conjunctival sac” is the least frequently registered of the entire group – one case for the entire period (a 15-year-old girl).

It is assumed that the frequency of eye injuries among children in the city of Shumen is higher than established in the study, since a large part of pediatric cases of moderate and severe eye injuries requiring surgical treatment, as well as cases of children with polytrauma, are primarily consulted and managed in emergency medical care units and referred for hospitalization in hospital treatment structures, and these cases cannot be covered by this study.

The diagnoses in the "Strabismus" group also do not show significant dynamics in frequency from the beginning to the end of the study period, although they were registered slightly more often in 2019. (Table 8). Their frequency among the pediatric population decreases with increasing age, with over 54% of all cases of strabismus being found in children under 5 years of age. (Table 20). This observation is consistent with data from the United Kingdom [149], but contrasts with those from Guangzhou (South China), where strabismus is more prevalent in 7-12 year olds. [227]

The predominant diagnosis in the group is “Convergent concomitant strabismus”, which is most common in children under 5 years of age and least common in teenagers (divergent concomitant strabismus is most common in them). This trend is expected, since accommodative esotropia associated with hyperopia (which decreases with age) is more common in young children.

The diagnosis “Strabismus, unspecified” is also more common in children under 5 years of age, and its frequency decreases sharply with age (no cases were recorded in the 12-17 year age group). This may be due to the difficulties in performing an ophthalmological examination in the youngest patients and, consequently, the more difficult diagnosis, especially when it comes to tests that require good cooperation on the part of the patient. The dynamics of the prevalence of diagnoses in the “Other” group will be considered individually.

Amblyopia is rare in the study population (0.62% of all leading diagnoses for the entire study period, Table 11). In comparison, a much higher incidence of amblyopia in the pediatric population was reported in France (3%) [65], and in Southern China – just over 7% [254]. There are also countries with lower levels of amblyopia, such as Tanzania, where only 0.2% of the children studied were diagnosed with “lazy eye”. [135]

According to data from the city of Varna, during a screening program in 2013, amblyopia was detected in 5.02% of children between 6 and 7 years of age. [240] Of interest are the results of the same screening program, but conducted five years later (the screening was conducted annually for the period 2013-2018). In 2018, not a single case of amblyopia was registered among the screened children, which proves the meaning and effectiveness of vision prevention in childhood. [241] According to data from a screening program conducted in the city of Smolyan for the period 2013-2018, in children aged 4-5, amblyopia was found in just under 2% of all those examined.

No significant dynamics in the prevalence of amblyopia were reported in the different years of the study period. It was most often diagnosed in the age group 6-11

years (without differences between the two sexes), and least often in children under 5 years.

When analyzing the incidence of amblyopia reported in this study, it should be borne in mind that the prevalence of amblyopia among children in the city of Shumen may be wider. Since amblyopia is often asymptomatic and without obvious signs of impairment, it most often remains undiagnosed until late in life, when treatment is ineffective. Therefore, a screening program conducted annually and covering the largest possible percentage of the child population would not only provide a clearer picture of the prevalence of amblyopia, but would also be crucial for its prevention and timely treatment.

Color vision abnormalities are also among the rare leading diagnoses in children for the period 2019-2022, in the city of Shumen (0.08% of all diagnoses, Table 11). Only two cases were registered (one in 2020 and one in 2021), only in males (Table 22). For comparison, the screening program conducted in the city of Smolyan found impaired color perception in 3.6% of children [242]. Similar results were obtained in the city of Varna (3.36%) [241].

It is difficult to determine the real frequency of dyschromatopsia among children using the methods of the present study, since color vision testing is often omitted during a standard ophthalmological examination. This creates a prerequisite for late diagnosis of this type of disorder. Although color vision abnormalities are not treatable, their early diagnosis can help in the correct professional orientation of children in the future, since many professions require normal color perception.

Optic nerve atrophy was detected only once during the entire study period (0.04% of all diagnoses during the study period, Table 11), in a 14-year-old male. (Table 22), and this result does not allow for consideration of the dynamics of the frequency of diagnosis.

Congenital diseases are also among the least common leading diagnoses in the studied population, accounting for 0.24% of all leading diagnoses for the study period. In comparison, in Eastern India there is data on a significantly higher frequency of congenital eye pathology (9%), and it even ranks second in prevalence among refractive anomalies. [223] The results of the present study are closer to the data from Kathmandu, Nepal, where congenital pathology was found in 0.36% of eye diseases in the studied children. [224] When analyzing these results, it should be borne in mind that congenital diseases of the visual system, which manifest themselves symptomatically soon after birth, are usually consulted on site in the neonatal department and referred (when this is promising) for surgical treatment in specialized eye hospitals in cities neighboring the city of Shumen. This may affect the frequency of registered pathology in pre-hospital medical care offices, as children are usually monitored by their treating physician.

The diagnosis of “Congenital glaucoma” occurs once for the entire four-year period (0.04% of all leading diagnoses for 2019-2022, Table 11), in a boy under the age of 1 year (Table 22). The methods of the present study do not allow for an accurate statement of the frequency of congenital glaucoma in the city of Shumen and a comparison with other sources. According to literature data, congenital glaucoma

occurs more often in boys [178], which is also confirmed by the results obtained. Congenital cataract was registered twice for the entire study period (once in 2019 and once in 2022, 0.08% of all leading diagnoses for the period, Table 11), in males between 6 and 11 years old (Table 22). In Guangzhou (South China), congenital cataract was detected in a much higher percentage of persons up to 18 years old. (13.6%) [254]. The large difference in reported results is likely due to the different types of medical institutions from which the information was extracted. While the present study used data from outpatient ophthalmology clinics, the study in China was conducted in a specialized eye hospital. Due to the specificity and difficulties in the treatment of pediatric cataract, specialized eye hospitals often refer many cases diagnosed in other cities, which increases the percentage of registered patients with this disease in the respective medical institution. Iris coloboma was registered once in the study population for the period 2019 -2022 (0.04% of all leading diagnoses for the period, Table 11), in a 17-year-old boy (Figure 8). The frequency of this diagnosis is too low to be subjected to comparative analysis, but the high age of the person in whom it was found is striking, since congenital eye anomalies are more often diagnosed at a much younger age.

Congenital eyelid ptosis was diagnosed twice during the study period (two cases in 2019, 0.08% of all diagnoses for the period 2019-2022, Table 11) in a boy aged 0 and in a boy aged 8 (Table 22, Figures 6 and 7). For comparison, in the specialized eye hospital in Guangzhou (South China), congenital ptosis was diagnosed in 9% of all children who passed through the hospital for the period 2010-2019. [254]

“Conjunctival hemorrhage” is also a rare leading diagnosis, accounting for 0.19% of all diagnoses for the entire study period (Table 11). It was diagnosed only in individuals over 5 years of age (Table 22). No significant dynamics in prevalence were reported for this pathology during the study period.

Preretinopathy was registered twice for the entire period (two cases in 2020, 0.08% of all leading diagnoses, Table 11) in a boy and a girl aged 0 (Table 22). The incidence of preretinopathy among children in the city of Shumen is probably higher than reported, since premature children are monitored on site by an ophthalmologist, even before their discharge from hospital, and the registered cases are often referred to units with experience in the diagnosis and treatment of ROP, in larger regional cities.

The diagnosis “Retrobulbar neuritis” occurs only once during the study period (one case in 2019, 0.04% of all diagnoses, Table 11), in a 14-year-old girl (Table 22). The low incidence of this disease does not allow for an assessment of the dynamics of its spread.

“Stenosis and insufficiency of the tear ducts” occurs rarely, with approximately the same frequency in each of the years covered by the study and makes up 0.82% of all diagnoses during the study period (Table 11). This diagnosis was registered only in children under 1 year of age and 1 year of age (Figure 28, 31, 34 and 37). Data from Western India show a significantly higher proportion of this diagnosis among children there (5.2%), but it must again be taken into account that the Indian study was conducted in a specialist eye hospital, where cases are likely to be referred from multiple parts of the country, which could lead to a higher incidence of diagnoses requiring hospital treatment. [222]

The next most common group of diseases among children aged 0 to 17 years inclusive is “Inflammatory diseases of the cornea, sclera and uvea”. It includes the diagnoses “Keratitis”, “Episcleritis” and “Iridocyclitis”. Keratitis is the most common in the group under consideration, with a relatively constant frequency in 2019, 2020 and 2022 (0.43%, 0.29% and 0.48% of all leading diagnoses, respectively, Table 4), but in 2021 not a single case was registered. However, this dynamics is not statistically significant and cannot be considered as an influence of the pandemic period on this type of morbidity. As for the age distribution, keratitis was diagnosed only in the 12-17 age group, more often in boys (Table 15).

This result is similar to the data on the incidence of keratitis in the pediatric population in Minnesota, USA. [36] There, the median age of patients diagnosed with keratitis was 15 years, but unlike the present study, it was more common in females.

Episcleritis was also diagnosed only in individuals over 12 years of age, again more common in boys (Table 15). It occurs less frequently than keratitis (0.12% of all leading diagnoses for the period, Table 4), with only 3 cases recorded during the entire study period (one case each in 2019, 2020, 2021, and none in 2022). Due to the low incidence of this pathology in the study population, no significant dynamics in the prevalence of episcleritis in childhood could be traced during the study period.

Iridocyclitis is the only pathology in the group under consideration, found not only in 12-17-year-olds, but also in the 6-11-year-old group. (Table 15). A total of 3 cases of iridocyclitis were registered for the entire study period (0.12% of all leading diagnoses), all three of which were in 2019 (Table 4). This pathology is rare in the study population, with its prevalence being sporadic and no influence of the pandemic period on the prevalence rate can be noted.

The group of tumor diseases is the last in frequency. The diagnosis “Other conjunctival vascular diseases and cysts” prevails over the others (0.16% for the entire study period, Table 7), occurring only in persons over 6 years of age. (Table 19).

The diagnosis “Hemangioma of the eyelid” was diagnosed only once during the study period, in a girl under 1 year of age. (Table 19).

Malignant neoplasm of the retina was also diagnosed once for the period 2019-2022, in a 3-year-old girl (Table 19).

The diagnoses in the group "Tumors" have a relatively equal frequency in 2019, 2020 and 2021 (0.29%, 0.30% and 0.34%, respectively, Table 7), but in 2022. not a single case of ocular tumor in childhood was registered. Due to the very low frequency of this type of pathology, its spread is rather sporadic in the studied population, without the influence of the coronavirus pandemic being attributed.

Unfortunately, a large part of the ophthalmological pathology in childhood in the territory of the city of Shumen remains outside the scope of the study, due to the fact that the information used is from outpatient eye examinations of children whose parents actively sought a specialist or were referred to one after a pathology was identified by the general practitioner. The percentage of registered preventive examinations is low, and in most cases the children had complaints that determined the leading diagnosis.

To obtain a clearer picture of childhood eye morbidity, as well as to ensure prospects for good eye health in the younger generation, it is necessary to develop a national program for eye screening in childhood.

Key factors for the reliability and effectiveness of screening programs are the team performing the examination, the compliance of the ophthalmological examination with the age of the children undergoing screening and the set criteria for the norm, in relation to the studied groups. The screening program should include simple and quick tests, and it is important that they are not only effective, but also financially unburdening. This would allow for the widespread implementation of eye screening in both large cities and small settlements. The screening program for children's eye health should target diseases that have a high prevalence and for which there is a possibility of effective treatment or correction if diagnosed in a timely manner.

High-grade refractive errors are a leading cause of visual impairment in childhood and the most widespread ophthalmological pathology among children in countries with high and medium economic development, as evidenced by both the present study and global literature sources. Therefore, screening programs for children's eye health are most often aimed at diagnosing refractive errors and related deviations, such as strabismus and amblyopia.

Visual acuity testing is the basis of any screening program and can be performed on-site in educational institutions. The test can be performed by medical personnel (nurse) or by volunteers with non-medical education (parents, teachers), after completing a standard training course. Such a practice exists in countries such as the USA and Canada, where screening examinations of students are often performed by volunteers without medical education, teachers, and often by the parents themselves. While in Bulgaria, larger settlements are relatively well-equipped with qualified medical personnel, in smaller towns and villages it is extremely insufficient. Assigning the performance of eye screening in childhood only to specialists in Ophthalmology and nurses would significantly limit its implementation, which is expected to have an impact on the early diagnosis and treatment of ophthalmological pathology in childhood. The visual acuity test is quick and non-invasive, poses no risk to the research and the examiner, and its performance, even by teachers or parents who have completed the necessary training course, could have a positive impact on children's eye health. For this purpose, vision charts with digital or picture optotypes can be used, which are economically advantageous, but require certain conditions in the room, such as ensuring an appropriate examination distance. Electronic vision chart projectors are more convenient and can be used in smaller rooms, without the need for a mirror to double the distance, but on the other hand they are more expensive. The vision test should be performed sequentially on each eye separately, and the result should be documented and presented to the parents, along with the relevant recommendation for a specialized examination as soon as possible (if reduced visual acuity is detected in one or both eyes) or for annual vision prophylaxis (if normal visual acuity is detected).

The ocular motility test, as well as the Hirschberg test for ocular deviation, are also easily applicable, informative, cost-effective and rapid methods suitable for use in screening programs, and again can be applied by both medical personnel and volunteers with non-medical education, after passing the appropriate instruction.

The present study found a high frequency of diagnoses related to asthenopia, accommodative disorders and headaches. The introduction of a brief history in the screening examination, aimed at detecting the possible presence of complaints related to prolonged visual load (headache, transient blurred vision, burning and irritation in the eyes), would help in the timely diagnosis of these deviations in children who may not show other signs of visual impairment. The presence of these symptoms in childhood may indicate the presence of a “hidden diopter”, poor eye hygiene or both, and these children should also be referred for a specialized eye examination as soon as possible. The introduction of an anamnestic element in the screening examination should be tailored to the age of the children being examined. Although according to the data from the present study, the diagnoses “Accommodative disorders”, “Subjective visual disturbances” and “Headache” are also registered in persons under 5 years of age, children of this age would have difficulty formulating their complaints well, and in addition, they are more often worried and reserved towards the examiner, compared to children from the above age groups, especially if the screening is conducted by a stranger (as is the case in most cases). Therefore, anamnestic data should be included in the screening examination of children over 6 years of age (where the frequency of this type of disorders is highest).

While in preschool and school age the screening examination is relatively easy and quick, due to the age of the children and their ability to actively communicate and cooperate with the team during the examination, in younger children (6 months, 1 year, 3 years) more time, experience and medical training are required, and the screening needs to be performed by a doctor (pediatrician or ophthalmologist) or a nurse. According to the current Bulgarian legislation, children with a family history of cataracts, glaucoma, strabismus, hyperopia, high myopia, amblyopia and retinoblastoma are subject to a prophylactic examination for the detection of congenital eye pathology twice - at 6 months and one year of age, by the child's personal physician. Covering all children between six months and one year of age with a preventive eye examination, regardless of the presence of a family history of eye pathology, would increase the chances of early diagnosis of congenital diseases and reduce the possibility of missing a serious ophthalmological disease at this sensitive age for the development of the visual system, since congenital eye diseases are not always hereditary and have obvious signs and symptoms.

There are many methods for limiting the main factors from the external environment that increase the risk of developing myopia in childhood, which are easily applicable, non-invasive and financially - not burdensome. Introducing more outdoor activities into the school curriculum, reducing screen time for entertainment in children's daily lives and replacing it with sports activities, organizing training for teachers, parents and children on the rules of vision hygiene and the importance of regular preventive examinations, would significantly reduce the risks to children's eye health in the modern digitalized world.

6.CONCLUSIONS

1. The results of the study are statistically significant and comparable with data from the world scientific literature.
2. The characteristics of pediatric eye morbidity in the territory of the city of Shumen are close to those registered in other cities of Bulgaria, as well as in other European countries, but have their own individual characteristics, the most prominent of which is the high frequency of accommodation disorders and asthenopia.
3. The coronavirus pandemic and anti-epidemic measures are associated with both an increase in the frequency of myopia and an increase in accommodation disorders and asthenopia complaints in the pediatric population in the city of Shumen.
4. The decrease in the frequency of infectious conjunctivitis in childhood during the period 2020-2021 can be considered as a positive side of the measures introduced to limit the spread of COVID-19.
5. It is necessary to organize an annual program for the prevention of children's eye health at the national level, which should be comprehensive, generally accessible and tailored to the characteristics of children's eye morbidity in the examined area.
6. There are many methods for limiting the main factors of the external environment that increase the risk of developing myopia in childhood, which are easily applicable, non-invasive, financially unburdening and would significantly reduce the risks to children's eye health in the modern digitalized world.

7. ABSTRACT

7.1 Introduction

Prevalence of ophthalmic diseases in childhood shows significant variability in different parts of the world and is a reflection of both the economic and social development of the country and the accessibility of qualified medical care.

The trend of increasing myopia incidence among children worldwide is alarming. Numerous scientific papers from different parts of the world prove the connection between the occurrence and progression of myopia in childhood and the restrictions introduced during the coronavirus pandemic.

The digitalization of the world is a modern challenge to children's vision. The ophthalmological prospects for children's eye health in the modern, screen-flooded world depends on the timely and adequate therapeutic approach of healthcare professionals, on the accessibility of prophylactic examinations and last but not least, on the awareness of teachers, parents and children themselves about the importance of timely prevention and responsible vision care in the family and school environment.

7.2 Aim

To create an epidemiological picture of pediatric eye morbidity in the city of Shumen, to track the factors modulating its characteristics and to formulate recommendations to ensure positive prospects for pediatric eye health, based on the results obtained.

7.3 Objectives

1. Collection of medical information from ophthalmological examinations of children (0-17 years old incl.) from three medical institutions - DCC1 Shumen Ltd, MC MHAL Shumen Ltd and ASMH "Dr. Ralitsa Emilova Neykova-Marinova" Ltd for the period 01.01.2019 - 31.12.2022.
2. Statistical analysis of the distribution of ophthalmological pathology in childhood on the territory of the city of Shumen for each year of the research period and in total for the entire research period;
3. Tracking the dynamics of pediatric eye morbidity in the period before, during and after the COVID-19 pandemic.
4. Comparison of the obtained results with data from studies on the distribution of pediatric eye pathology from foreign and local literary sources.
5. Formulation of recommendations for optimizing ophthalmological screening in childhood;

7.4 Methods

This retrospective scientific study is based on information from primary outpatient ophthalmological examinations of children (0-17 years old), for the period 01.01.2019-31.12.2022, conducted by a total of 6 ophthalmologists, on the territory of DCC1 Shumen Ltd, Medical center in Multi-profile hospital for active treatment-Shumen Ltd and ambulatory practice for specialized medical care – "Dr. Ralitsa Emilova Neykova-Marinova" Ltd

Data was extracted by processing outpatient lists in the pre-hospital medical care software used in the respective medical centers or by processing outpatient lists and journals on paper, stored in an archive.

The following information was extracted from the outpatient lists – date of examination, age and gender of patient and leading diagnosis, according to the International Classification of Diseases (ICD – 10).

The information from the different medical centers was merged and structured into a database in Excel, after which it was subjected to statistical analysis.

7.5 Results

Refractive anomalies are the most common reason for a primary eye examination among those aged 0-17 years (inclusive), who underwent a primary eye examination in the pre-hospital medical care facilities included in the study, for the period 2019-2022. They are most often diagnosed in the age group 12-17 years, and in females.

Diagnoses related to accommodation disorders, visual asthenopia, and headache were the second most common among children during the study period, with children between the ages of 6 and 11 being – most affected. This type of pathology was also more common among girls than boys.

In third place in terms of prevalence is infectious conjunctivitis. It occurs most often in the age group 0-5 years. Infectious conjunctivitis occurs more often in boys.

In fourth place in terms of prevalence for the period of study are diagnoses related to inflammation of the eyelids. They are most often registered in children under the age of 12, with females being more affected than males.

Allergic eye inflammations are ranked fifth as a reason for primary eye examination in people up to 17 years old in the city of Shumen, for the period 2019-2022. The most allergic eye inflammations are registered in the age group 6-11. No differences in the incidence between girls and boys are found in the general population.

Eye trauma was the sixth most common reason for primary eye examination in childhood during the study period. Traumatic eye injuries were most frequently observed in the 12–17-year-old group and least frequently in children under 5 years of age, with boys being affected significantly more frequently.

The seventh most common diagnosis in the study population is "Eye and vision examination", which refers to a prophylactic eye examination without an established ophthalmological pathology. As age increases, the frequency of the diagnosis "Eye and vision examination" in the study population decreases.

Strabismus is the eighth most common reason for primary eye examination in persons up to 17 years of age (inclusive), during the study period. It is registered most often in children up to 5 years of age and its frequency decreases with age. When considering the gender distribution in the general population (0-17 years), strabismus is observed to affect boys more often than girls.

Amblyopia is rarely observed in persons up to 17 years of age for the period 2019-2022 in the city of Shumen, and the reported frequency of this diagnosis (0.62%) is lower than that indicated in most local and foreign literary sources. Amblyopia is most often registered among children aged 6-11 years and boys are more affected than girls.

The second-to-last place in terms of prevalence in childhood, during the study period, were diagnoses related to inflammation of the cornea, sclera, and uvea. They were observed only in children over 6 years of age, more often in boys.

Diagnoses in the group of tumor eye diseases are rarely observed in the studied population, including both benign and malignant tumors of the visual system (a single case of malignant retinal neoplasm). Their distribution is rather sporadic, with no difference in frequency between genders in the general population.

Congenital eye diseases are also among the least common leading diagnoses in the studied population, and they are observed more often in males.

Among the less common diagnoses in children who underwent a primary eye examination at the prehospital care centers included in the study during the period 2019-2022 were "Conjunctival hemorrhage" - five cases, "Preretinopathy" - two cases, "Color vision abnormalities" - two cases, "Optic nerve atrophy" - one case, and "Retrobulbar neuritis" - one case.

Statistically significant dynamics in the prevalence before, during and after the coronavirus pandemic have been found for certain leading diagnoses. During the pandemic period (2020-2021), an increase in the frequency of myopia, an increase in accommodation disorders and asthenopic complaints, and a decrease in the frequency of infectious conjunctivitis in childhood were reported.

7.6 Conclusions

1.The results of the study are statistically significant and comparable to data from the world scientific literature.

2.The characteristics of childhood eye morbidity in the territory of the city of Shumen are close to those registered in other cities in Bulgaria, as well as in other European countries, but have their own individual characteristics, the most prominent of which is the high frequency of accommodative disorders and asthenopia.

3.The coronavirus pandemic and anti-epidemic measures are associated with both an increase in the incidence of myopia and an increase in accommodation disorders and asthenopic complaints in the pediatric population in the city of Shumen.

4.The decrease in the incidence of infectious conjunctivitis in childhood during the period 2020-2021 can be considered a positive side of the measures introduced to limit the spread of COVID-19.

5. It is necessary to organize an annual program for the prevention of children's eye health at the national level, which should be comprehensive, generally accessible and tailored to the characteristics of children's eye morbidity in the examined area.

6. There are numerous methods for limiting the main environmental factors that increase the risk of developing myopia in childhood, which are easily applicable, non-invasive, financially unburdening, and would significantly reduce the risks to children's eye health in the modern digitalized world.

8. CONTRIBUTIONS OF THE DISSEARTATION

8.1 CONTRIBUTIONS OF A COGNITIVE NATURE

1. An in-depth literature review has been made on the characteristics and prevalence of ophthalmic pathology in childhood, both around the world and in different parts of Bulgaria.
2. An in-depth literature review has been made on the impact of the COVID-19 pandemic on children's eye health.

8.2 CONTRIBUTIONS OF A SCIENTIFIC NATURE

1. A statistical analysis of the distribution of ophthalmic diseases in childhood for the period 2019-2022 has been made. on the territory of the city of Shumen.
2. The dynamics of childhood eye morbidity in the period before, during and after the COVID-19 pandemic have been tracked.
3. Recommendations have been formulated for improving eye screening programs in childhood.

8.3 CONTRIBUTIONS OF AN AFFIRMATIVE NATURE

1. The impact of the coronavirus pandemic on children's eye health has been proven - an increase in the frequency of myopia, an increase in the cases of accommodation disorders and asthenopic complaints and a decrease in the frequency of infectious conjunctivitis in childhood.

9. SCIENTIFIC PUBLICATIONS RELATED TO THE DISSERTATION

-Visual displays – a modern challenge for children's eye health – GP NEWS, issue 6, 2023

-Childhood myopia and COVID-19 pandemic – around the world and in our country – GP NEWS, issue 6, 2024