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A comparative study of regional variations in common visual impairments among school-age children

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ABSTRACT

Purpose: This study aims to examine the incidence and age-related prevalence of eye conditions among school-age children living in Moscow Region (Russian Federation) and Riyadh (Saudi Arabia).

Methods: The study sample includes 573 visually impaired children aged 7-17 years (13.85±1.24 years) in Russian Federation and 600 children (13.78±1.11 years) in Saudi Arabia.

Results: Myopia in Russian Federation was with a prevalence rate of 35.6%, followed by astigmatism (21.3%), strabismus (16.2%), conjunctivitis (13.6%), hyperopia (10%). The incidence of visual impairment was lower for children from Saudi Arabia compared to Russian Federation (OR=1.01, 95% CI [0.85-1.17] in 2018, OR=0.93, 95% CI [0.83-1.03] in 2022 in Saudi Arabia and OR=1.36, 95% CI [1.25-1.47] in 2018 vs. OR=1.33, 95% CI [1.23-1.43] in 2022 in Russian Federation). In Saudi Arabia, myopia occurred in 10% of cases at 7-10 years, 20% at 11-13 years, and 25% at 14-17 years.

Conclusion: The satisfactory state of the health system in Saudi Arabia compared with Russian Federation has resulted in a lower incidence of visual diseases among children. The possible causes of the myopia prevalence are worse medical system in the Russian Federation compared to Saudi Arabia, and climate in both countries.

Keywords: children, conjunctivitis, eye diseases, myopia, ophthalmology, Russian Federation, Saudi Arabia

INTRODUCTION

More than 80% of all information comes from the eyes, which makes our visual system the most important organ of sense [1, 2]. Clear sight is especially important for children, as they learn to perform visually demanding tasks, such as drawing, writing, reading, and more. Childhood vision impairment and blindness are known to negatively affect psychomotor development, cognitive function, employment, and well-being [3].

According to World Health Organization, about 2.2 billion people worldwide suffer from visual impairments. Of these, 19 million are children [4-6]. The prevalence of childhood blindness in CIS countries is much higher than in fully developed ones (3-4 per 10,000 children) and ranges from 12 to 15 per 10,000 children. A blind child is more likely to die in childhood than a child with normal vision, especially in low-income countries [3].

Approximately, 12 million children have refractive errors, and 1.4 million have a severe and irreversible visual impairment [1]. The most common visual impairment is myopia (i.e., near-sightedness). Some forecasts even suggest that it will affect 50% of the world population by 2050 [7]. Globally, 10 million children suffer from myopia, the vast majority of whom are age 10 and older [3].

There are many causes of visual impairment, such as uncorrected refractive errors, retinal disorders, cataracts, glaucoma, corneal scarring from hypovitaminosis A, neurological disorders, and more [8-10]. Neurological diseases include optic nerve diseases, pathologies related to the development of a tumour inside the skull or to high intracranial pressure (optic neuritis, neuropathy). The major risk factors for childhood visual impairment are low birth weight, premature birth, large head circumference, caesarean section, maternal alcohol consumption during pregnancy, being white, genetics, being female, living in a low-income family, and prolonged screen time [11, 12].

Considering the high prevalence of sight defects and their negative effect on one's development and quality of life, it is vital to diagnose and prevent such disorders early. Pediatricians play a central role in the detection of visual abnormalities, as they more often than other doctors come into contact with children [13]. However, it may be challenging to get an early diagnosis because school-age children may not be able to timely recognize the symptoms [14, 15].

As mentioned above, the incidence of visual impairment in developed and developing countries can differ. In Russian

Federation, which is a developing country with a rapidly deteriorating economy and health care system, children with vision problems can receive primary and specialized care. Most of the existing specialized ophthalmology clinics were founded and equipped back in the days of the Soviet Union, that is, 50 years ago. In general, there are about 2,000 pediatric ophthalmologists currently serving visually impaired children in Russian Federation. According to rough estimates, parents can choose between 70 ophthalmological hospitals, 1,500 outpatient polyclinic institutions, 300 pediatric eye care offices, and 10 centers for eye microsurgery. In addition, there are many specialized schools for visually impaired and blind children [11, 12]. Even though pediatric ophthalmology in Russian Federation has witnessed a faster growth rate in recent years, there are still issues impeding more effective care. Among them is the shortage of pediatric ophthalmologists and high-quality equipment [16]. Despite the significant number of ophthalmology clinics in Russian Federation, they are ineffective. This is proved by updated statistics of Ministry of Health of Russian Federation for the year 2022: 11 people out of 100 have problems with eyesight organs, i.e., 16 million people have eyesight problems. The only group that has a lower incidence of vision disorders is people of working age (six people out of 100). Child myopia may evolve into the so-called age-related hyperopia (presbyopia) in old age. Presbyopia develops independently and simply adds its symptoms to the overall picture. In this case, myopia will not disappear anywhere, a person will not be able to see better in the distance, and in addition to this, near vision will also worsen.

About 31 million people in Russian Federation have a permanent deterioration of vision, of which more than half a million have completely lost their vision. These figures are 30% higher than similar statistics for the period 1990-2000, which indicates a permanent worsening of the problem of visual impairment in Russian Federation [17].

As an opposite example, i.e., a country with a successful health care system, Saudi Arabia can be cited. Saudi Arabia has one of the best health care systems in the world. Clinics and hospitals, including ophthalmological ones, are equipped with the most modern facilities. There are no problems in getting care not only in big cities, but also for the rural population [18]. Nevertheless, most world-renowned ophthalmology clinics are located in the capital, Riyadh. The high quality of medical care is due to the fact that 8% of the total budget is allocated to medicine annually [19]. This figure exceeds even that of the developed countries of Western Europe, not to mention Russian Federation and countries of the post-Soviet region. The system of institutions involved in the therapy and prevention of eye diseases includes public clinics and hospitals, as well as private institutions, including charitable ones. In rural areas, public outpatient clinics and health care facilities are represented. Since the government guarantees health care to all Saudi citizens, the health care system can be called national. Private clinics are also constantly improving and enhancing their services [20]. Ministry of Health is assigned to provide primary care. In case of further examination, family physicians and specialized ophthalmologists are included. In parallel, the performance of public and private clinics is monitored. For example, 12,000 doctors are allocated annually to serve pilgrims alone. In total, there are 200 clinics in Saudi Arabia, of which two-thirds are public and the rest are private [19]. The government plans to open 100 more clinics over the next five-10 years and train an additional 7,000 doctors. These data indicate the efficiency of the Saudi Arabian medical system. In Saudi Arabia, 80% of cases of eye disease are in the age group of 50 and older, due to irreversible senile changes. Among children, the incidence of eye disease is 10 times lower. As of 1986, 7.8% of the population was visually impaired and 1.5% were blind [21]. Today, this incidence has decreased five times, but an increasing proportion of visual impairment is due to diabetes. In 1986, diabetes accounted for 2.5% of visual impairment; in 2018, it accounted for 30% [22]. In the Russian Federation in recent years, the incidence of visual organ disorders has increased by 1.5-2.0 times compared to the average European rate. At the same time, there are significant differences between regions. These differences associated with the quality of ophthalmological services. Additionally, the number of incidences is 2.0 times higher among people of older working age than among young people and children. Glaucoma accounts for 15-20% of all reported cases [23]. In Saudi Arabia, these indicators are at the level of the developed European countries, i.e., 1.5-2.0 times lower than in the Russian Federation [24]. Among men in both countries, the number of visual disorders is 30% lower. There are no differences in the structure of the disorders between men and women [23, 24].

To model the development of vision diseases, future trends, it is relevant to compare the state and structure of morbidity in two model countries with different states of the health care system [25, 26]. Such countries suitable for comparison are Russian Federation (degrading health care system) and Saudi Arabia (constantly improving quality of medical care). The population of the Russian Federation is 143.4 million people, while there are 39.95 million people in Saudi Arabia. That is, Saudi Arabia has a 3.5 times smaller population with a comparable number of clinics. In Saudi Arabia, ophthalmological services are available even in remote regions, whereas in the Russian Federation, the quality of services decreases with the distance from the capital and large cities, since specialized clinics may simply not be available in rural areas [23, 24].

Most sight defects are preventable and treatable. Reliable data on the prevalence and causes of visual impairment in children are required to develop screening programs for early identification of children at risk and thus reduce both short- and long-term expenses in the health care system [14, 16]. The authors assume that there will be differences in the structure of visual diseases among children from Russian Federation and Saudi Arabia. The present paper seeks to analyze the status and structure of visual diseases among children living in Saudi Arabia and in Russian Federation. Moscow (Russian Federation) and Riyadh (Saudi Arabia) were considered for the analysis. The secondary objective of the study is to evaluate the quality of outpatient care delivered to those children.

METHODS

This study consists of two stages. Stage I involved an investigation evaluating the incidence of ophthalmologic abnormalities in school-age children, the structure of ophthalmologic morbidity, and the quality of care delivered to visually impaired children by polyclinics in the Moscow Region (Russian Federation) and in Riyadh (Saudi Arabia). The sample of the population selected from the metropolitan regions of both countries does not fully reflect the general trends, since the quality of medical care in the capitals is higher compared

Table 1. The incidence of pediatric eye conditions, ophthalmologist visit frequency, & record number of patients treated in ophthalmological in-patient units in 2018 & 2022 in Russian Federation & Saudi Arabia

Variable	Russian Federation			Saudi Arabia		
	2018	2022	D (%)	2018	2022	D (%)
Incidence of eye conditions among children (per 10,000 children)	1,428.30	1,631.70*	+11.40	557.60	458.10*/*	-20.00
Incidence of eye conditions among rural children (per 10,000 children)	1,611.60	1,828.30*	+11.30	526.50	449.40*/*	-20.10
Incidence of eye conditions among urban children (per 10,000 children)	1,239.40**	1,442.10*/**	+11.60	555.50	447.70*/*	-20.20
Number of visits to an ophthalmologist (per visually impaired child)	2.81	3.16	+12.45	4.89	5.17	+13.15
Number of children treated in ophthalmological in-patient units	3,286.00	3,023.00	-8.00	1,111.00	987.00	-10.00

Note. *The difference is statistically significant when compared to 2018 ($p<0.05$); **The difference is statistically significant when compared to urban children ($p<0.05$); The focus is on diseases of the eye and adnexa (H00-H59, ICD-10); & D: Difference

to remote regions. This is especially true of Russian Federation. Thus, this fact was included in limitations of the study.

In the first stage, the investigation consisted of reports from Ministry of Health of both countries, published between 2018 and 2022, and ophthalmologists' documentation provided by the participating polyclinics. The examined material displays the registered number of ophthalmological diseases per district and results of preventive examinations. When analyzing the incidence of eye abnormalities, the focus was on the whole spectrum of diseases in the eye and adnexa (H00-H59, ICD-10). Stage II in Russian Federation involved the review of medical records of 573 school-age children who underwent vision screening. The sample consists of 294 girls (51.3%) and 279 boys (48.7%). Among those, 262 (45.7%) were rural children, and 311 (54.3%) resided in urban areas. The mean age of the examined patients was 13.85±1.24 years (range, seven-17 years). 132 (23%) children were aged seven-10 years, 203 (35.4%) were aged 11-13 years, and 238 (41.6%) were aged 14-17 years. Children in both countries were selected based on parental consent (a signed contract guaranteeing confidentiality and anonymity of the data), presence of visual impairment, and regular visits to an ophthalmologist. In Saudi Arabia, 600 children, 299 girls (50%) and 301 (50%) boys, were included in the study. The average age was 13.78±1.11 years (ages seven to 17). Of these, 250 lived directly in Riyadh and the rest lived in the countryside around the capital. 150 children were seven-10 years old, 200 were 11-13 years old, and 250 were 14 to 17 years old. Statistical analysis was performed using the Wilcoxon t-test and student's t-test. Differences were considered statistically significant at $p<0.05$. The $\chi 2$ test was applied to compare qualitative findings. Odds ratios (OR) were calculated with use of PAST. Data processing was performed using SPSS 13.0 and Microsoft Excel 2013 (Microsoft, USA).

RESULTS

In Russian Federation (Moscow), more than half (73.1%) of school-age children undergo annual preventive screening regularly. The percentage of children examined annually varies between age groups: seven-10-year-olds, 87.3%; 11-13-year-olds, 75.9%; and 14-17-year-olds, 54.7%. For Riyadh, the figure is 99% (100% for 7-10 years old; 99% for 11-13 years old; and 99% for older children). Thus, children in Riyadh are significantly more likely to be examined by an ophthalmologist ($p\leq0.05$).

The analysis of ophthalmologists' documentation revealed an upward trend in visual impairment among school-age children over the last five years (OR=1.17, 95% CI [1.08-1.26], **Table 1**). Ophthalmological morbidity is significantly higher among rural than urban children, a trend that remains unchanged throughout the observation period (OR=1.36, 95% CI [1.25-1.47] in 2018 vs OR=1.33, 95% CI [1.23-1.43] in 2022). The population of Moscow swelled from 7.23 million in 2018 to 7.60 million people in 2022 [16]. The number of annual eye doctor visits per visually impaired child also increased, but the number of kids being treated in specialized hospitals decreased (**Table 1**). At the same time, for children from Saudi Arabia there was a decrease in the frequency of visual impairment (OR=1.01, 95% CI [0.85-1.17] in 2018 vs. OR=0.93, 95% CI [0.83-1.03] in 2022), and no significant difference was found between children from the capital and rural areas in the frequency of visual impairment, meaning they received necessary medical services to the same extent.

In Russian Federation, the most common ophthalmological abnormality was a refractive error (51.6%), followed by conjunctivitis (13.6%) and strabismus (7.4%). Myopia accounts for 48.3% of refractive cases. The most common ophthalmological disturbances that cause childhood disability were diseases of the optic nerve (32.5%), myopia (21.9%), and retinal diseases (9.2%). Their incidence is lower in Saudi Arabia: refractive error (21.3%), followed by conjunctivitis (3.2%) and strabismus (0.4%). Myopia occurred in 31.2% of cases. Causes of eye diseases were the same as in Russian Federation, but with lower frequency of occurrence: diseases of the optic nerve (17.3%), myopia (9.8%), and retinal diseases (3.5%).

The quality-of-care analysis revealed the scope and nature of ophthalmologic outpatient services. In Russian Federation, of all the visits to ophthalmologists, 65.3% were preventive visits, 11.9% were elective visits, and 6.1% were follow-up visits. Interestingly, only 82.5% of schoolchildren made timely visits. For Saudi Arabia, 99% of children had preventive visits to an ophthalmologist, 5% had routine visits, and 20% had follow-up visits. This suggests that there is a greater emphasis on prophylactic eye care in Saudi Arabia, with fewer routine visits due to the lower number of eye diseases in the population, including children. Timely visits to doctor were 99% of cases.

In Russian Federation, a laboratory-instrumental examination was ordered at almost all (98.4%) preventive visits. Among the examined school-age patients, 4.2% did not need outpatient treatment, 18.5% were at risk, 50.1% were apparently healthy but needed dynamic observation, and 27.3% had eye problems. Of those who needed treatment, 28.4% were untreated or received inappropriate care.

In Saudi Arabia, all children underwent laboratory tests, of which 45% did not need outpatient treatment, 30% were apparently healthy but needed to be evaluated dynamically. About 10% were at risk and 15% had visual problems. The number of children who received inappropriate care was much lower than in Russian Federation (0.5%).

Table 2. The age-related prevalence of eye conditions among school-age children in Russian Federation & Saudi Arabia

Eye condition	Age group	n	p-value
Myopia	7-10 years, Russian Federation	33	p1=0.029* p2=0.003** p3>0.05
	7-10 years, Saudi Arabia	55	
	11-13 years, Russian Federation	74	
	11-13 years, Saudi Arabia	94	
	14-17 years, Russian Federation	97	
	14-17 years, Saudi Arabia	151	
Hyperopia	7-10 years, Russian Federation	13	p1>0.05 p2>0.05 p3>0.05
	7-10 years, Saudi Arabia	4	
	11-13 years, Russian Federation	20	
	11-13 years, Saudi Arabia	5	
	14-17 years, Russian Federation	24	
	14-17 years, Saudi Arabia	6	
Astigmatism	7-10 years, Russian Federation	28	p1>0.05 p2>0.05 p3>0.05
	7-10 years, Saudi Arabia	25	
	11-13 years, Russian Federation	37	
	11-13 years, Saudi Arabia	36	
	14-17 years, Russian Federation	57	
	14-17 years, Saudi Arabia	40	
Strabismus	7-10 years, Russian Federation	21	p1>0.05 p2>0.05 p3>0.05
	7-10 years, Saudi Arabia	25	
	11-13 years, Russian Federation	38	
	11-13 years, Saudi Arabia	31	
	14-17 years, Russian Federation	34	
	14-17 years, Saudi Arabia	19	
Conjunctivitis & other inflammatory diseases of eye & adnexa	7-10 years, Russian Federation	31	p1=0.023* p2<0.001** p3=0.049***
	7-10 years, Saudi Arabia	15	
	11-13 years, Russian Federation	28	
	11-13 years, Saudi Arabia	9	
	14-17 years, Russian Federation	19	
	14-17 years, Saudi Arabia	6	
Diseases of optic nerve & retina	7-10 years, Russian Federation	1	p1>0.05 p2>0.05 p3>0.05
	7-10 years, Saudi Arabia	0	
	11-13 years, Russian Federation	1	
	11-13 years, Saudi Arabia	0	
	14-17 years, Russian Federation	1	
	14-17 years, Saudi Arabia	0	
Cataract	7-10 years, Russian Federation	2	p1>0.05 p2>0.05 p3>0.05
	7-10 years, Saudi Arabia	0	
	11-13 years, Russian Federation	3	
	11-13 years, Saudi Arabia	0	
	14-17 years, Russian Federation	2	
	14-17 years, Saudi Arabia	0	
Eye trauma	7-10 years, Russian Federation	2	p1>0.05 p2>0.05 p3>0.05
	7-10 years, Saudi Arabia	0	
	11-13 years, Russian Federation	1	
	11-13 years, Saudi Arabia	0	
	14-17 years, Russian Federation	2	
	14-17 years, Saudi Arabia	1	
Blindness	7-10 years, Russian Federation	1	p1>0.05 p2>0.05 p3>0.05
	7-10 years, Saudi Arabia	1	
	11-13 years, Russian Federation	1	
	11-13 years, Saudi Arabia	0	
	14-17 years, Russian Federation	2	
	14-17 years, Saudi Arabia	0	

Note. p1: Significance in comparison between 7-10-year-olds & 11-13-year-olds; p2: Significance in comparison between 7-10-year-olds & 14-17-year-olds; p3: Significance in comparison between 11-13-year-olds & 14-17-year-olds; *Significant differences between 7-10-year-olds & 11-13-year-olds (p<0.05); **Significant differences between 7-10-year-olds & 14-17-year-olds (p<0.05); & ***Significant differences between 11-13-year-olds & 14-17-year-olds (p<0.05)

In Russian Federation, most (91.5%) school-age patients were placed under outpatient observation in time, of whom 64.2% made irregular visits. Generally, 38.4% of visually impaired children did not complete the observation period. The leading reasons why were: the careless attitude of patients and their parents (36.3%), slow clinical course (27.4%), observation in multiple specialists (24.8%), unsatisfactory service delivery at first visit (6.5%), and no ophthalmologists employed (5%). In Saudi Arabia, all children were seen on time for outpatient follow-up, of whom only 10% had irregular visits to an ophthalmologist. Only 3% of the children did not complete their follow-up period, which was 10 times less than in Russian Federation. The main reason was negligence on the part of patients and their parents (87% of cases), in 13% of cases the reason was the observation by several specialists.

According to medical records, Russian Federation ophthalmologists often prescribe eye-moisturizing agents (29.8%), anti-infectives (26.5%), anti-allergens (21.9%), and anti-inflammatories (15.7%) to treat low vision. Other drugs make up 6.1% of all prescriptions. In Saudi Arabia, moisturizers are prescribed in 50% of cases (hotter and drier climate), antibacterial in 20%, anti-allergy in 15%, anti-inflammatory in 10%, and other drugs account for 5% of prescriptions.

The most common ophthalmological condition found among school-age children in the Moscow region was myopia (**Table 2**). It was observed in 204 patients (35.6%), followed by astigmatism in 122 patients (21.3%), and strabismus in 93 patients (16.2%). Inflammatory eye diseases were found in 78 children (13.6%), and hyperopia was detected in 57 children (10%). Less common conditions were cataract (seven children, 1.2%), ocular trauma (five children, 0.9%), blindness (four children, 0.7%), and optic nerve diseases (three children, 0.5%). Concomitant amblyopia was present in 82 children (21.4%) with refractive errors and 29 children (31.2%) with strabismus. For Riyadh, the pattern of eye diseases remained similar: myopia (300 patients, 50%), astigmatism in 101 patients (15%), strabismus in 75 patients (12%). Inflammatory processes were found in 30 children (5%), hyperopia in 16 (2.5%), blindness in one child, and amblyopia in 57 (10%).

In Russian Federation, the prevalence of the most common condition, myopia, was age related (**Table 2**). Children aged seven-10 years had a 25% prevalence of myopia, which increased to 36.5% for 11-13-year-olds and 40.8% for 14-17-year-olds. The prevalence of conjunctivitis decreased with age. It was significantly more common among seven-10-year-olds than among patients aged 11-13 (13.7%), and 14-17 years (23.5 vs 13.7 and 8%, respectively, p<0.05). No significant differences were observed between rural and urban children. In addition, there were no significant differences found between the sexes.

In Saudi Arabia, myopia is also the most common, and its incidence also decreases with age (**Table 2**). At seven-10 years of age, it was 10%; at 11-13 years of age, it was 20%; and at 14-17 years of age, it was 25%. Conjunctivitis decreased in frequency of occurrence from 20% in seven-10 years to 15% in 11-13 years and 1% in 14-17 years. The incidence of visual diseases did not differ significantly between urban and rural children. Gender was also irrelevant in incidence of visual diseases. Comparisons show that better health care system in Saudi Arabia compared to Russian Federation is responsible for lower incidence of visual diseases. Structure of diseases remains same, with changes depending on age.

DISCUSSION

Russian Federation, the State, and Structure of Visual Organ Disorders Among Children

In Russian Federation, data on ophthalmologic conditions reported over the last five years show a growing incidence of eye problems among children in Moscow Region (OR=1.17, 95% CI [1.08-1.26]). Such an increase can be explained by socio-economic factors, poor ophthalmological care, and a dramatic increase in children who spend long hours via their computers or smartphones [17, 27]. An extensive study involving more than 27,000 people in the age range of nine-26 years showed that myopia and asthenopia are more likely to occur in children who frequently use smartphones (95% CI 0.53-0.99, p<0.001 [27]).The results of this study align with similar research [11-13]. The prevalence of visual impairments was significantly higher among children living in rural than urban areas (p<0.05). Apparently, the economic profile of a settlement (e.g., GDP per capita, unemployment rate, poverty rate, etc.) plays a certain role in the development of eye diseases. Infrastructure, especially health care resources, also seems important. Other factors that affect the incidence of visual difficulties are taking evening classes, the proportion of the poorly educated population, and more. Based on those data, it becomes clear why the prevalence of visual impairments in this study was higher among rural children. Kids living in rural areas have limited access to high-quality medical services. In addition, rural outpatient clinics may not have pediatricians and enough nurses to deliver their services to children. Compared with economically developed urban areas, rural populations have lower levels of education, which also affects the situation. The data obtained in this study on the age patterns in ophthalmologic morbidity among school-age children coincide with state-level statistics [11, 12].

As regards the quality of pediatric ophthalmological care, the overall estimates are satisfactory. However, a relatively high percentage of children (28.4%) did not receive the treatment they needed. Of those, 18.9% were treated inappropriately and 9.5% received no care at all. In addition, only 61.6% of patients chose to complete the follow-up period. The leading causes of failure to deliver treatment were shortcomings of the primary health care system, poor communication performance in the consultation, and the lack of necessary specialists. Other reasons involve the careless attitude of children and their parents and patients' inability to afford or find high-quality care in their area of residence.

The age-related differences in the prevalence of myopia stem from the variation in age-specific activities. Older children focus their eyesight on close objects due to more intense learning and more screen time. They also tend to have poor nutrition and more bad habits compared to younger children. A high prevalence of conjunctivitis among younger children is associated with poor hand hygiene and more frequent hand-to-face contact.

Saudi Arabia, the State, and Structure of Visual Organ Disorders Among Children

There are quite a lot of studies conducted in recent years on the structure of visual diseases in Saudi Arabia [28, 29]. For example, based on a questionnaire survey of 1,941 people, it was found that if a person is addicted to a smartphone (and this addiction is more pronounced in girls, p=0.001), it is highly likely to lead to visual impairment [30]. Although the present study found no difference between the incidence of visual organ disease between urban and rural children, other studies have found this difference: rural children have 20% higher incidence (sample of 394 people) [31]. The present study involved 1.5 times the number of children, which may have influenced the results. Another study also indicates a higher incidence of visual impairment among residents of some remote rural areas [19]. The most common causes of bilateral blindness are retinopathy of prematurity, glaucoma, optic atrophy, and retinitis [24, 32]. Therefore, the factor of prematurity should be considered in the diagnosis. Among the population of Saudi Arabia, dry eye disease is the most common, but in a mild degree, which can be explained by the dry climate of the region [33]. Among the 940 people examined, 6% had glaucoma, but this disease was not detected in the present study, which may be due to its age-related features [18, 34]. Myopia is the most common condition not only among children in Saudi Arabia, but also among older age groups [22], in the general population of about 6%), from 19 years of age (sample of 162 students, ages 19-27) [20]. In the present study, blindness was diagnosed in only one child; according to recent data, the incidence of blindness has decreased by 50% [35]. According to other data, among more than 1,000 adolescents aged 12-20 years examined, refractive anomalies occurred in 55.5% of cases, of which a fifth could be cured [36, 37]. As in the present work, myopia was the most common, occurring in 53% of cases, indicating the ubiquity of this visual impairment in Saudi Arabia [38]. Among children aged nine-12 years (5,176 children in total), the prevalence of correctable visual impairment was 18.6%, of which 5.8% was myopia and 5.4% was astigmatism [38]. Among adults, there were 13.9% of cases of visual impairment, of which refractive errors were the main cause of the disease (36%) [21, 22].

The Assessment of Outpatient Care Quality Provided to Children in Both Countries

The present study provides evidence of the weak performance of outpatient ophthalmological facilities in the Moscow region (Russian Federation) compared to Saudi Arabia, which calls for outpatient care practice improvement in ophthalmology. It can be achieved in the following ways: integrating vision screening programs, improving the normative legal base, delivering customer service and empowering training to medical employees, implementing innovative medical equipment, and providing financial assistance for visually impaired children. In Saudi Arabia, assistive technology is already being introduced to help schoolchildren and students with visual impairments [20] become productive members of society.

CONCLUSION

The study showed that the better state of the health care system in Saudi Arabia compared to Russian Federation results in a lower incidence of visual diseases. For example, the incidence of myopia in Saudi Arabia is twice as low as in Russian Federation, as is the incidence of conjunctivitis. For children from Saudi Arabia, the incidence of visual disorders is lower than in Russian Federation (OR=1.01, 95% CI [0.85-1.17] in 2018, OR=0.93, 95% CI [0.83-1.03] in 2022 in Saudi Arabia and OR=1.36, 95% CI [1.25-1.47] in 2018 vs. OR=1.33, 95% CI [1.23-1.43] in 2022 in Russian Federation). In Saudi Arabia, as in

Russian Federation, the structure of vision diseases persists, with changes according to age. In Saudi Arabia, myopia is the most common, and its incidence decreases with age. At seven-10 years of age, myopia occurred in 10% of cases, at 11-13 years of age in 20%, and at 14-17 years of age in 25% of cases. Conjunctivitis among children in Saudi Arabia was decreasing in frequency, from 20% at seven-10 years to 15% at 11-13 years and 1% at 14-17 years.

In Russian Federation, the prevalence of myopia increased significantly with age, ranging from 25% in children aged seven-10 years to 36.5% in children aged 11-13 years and 40.8% in children aged 14-17 years. The prevalence of conjunctivitis was significantly higher in younger patients ($p<0.05$), ranging from 13.7% in 11-13-year-olds to 8% in children aged 14-17 years. Thus, high-quality medicine and regular examinations of children were able to ensure twice the lower incidence of myopia and conjunctivitis in Saudi Arabia compared to Russian Federation. It follows that the Saudi medical system can be used as a model for improving the existing systems in other countries.

Prospects for Further Research

Future research should focus on the prevalence and incidence of visual impairments among school-age children in other federal subjects of Russian Federation. Scholars may also examine the quality of life of visually impaired schoolchildren and develop measures to improve it. The limitation of this study is the age group of children, and the study localization. In both cases, a sample of children from the capitals of the two countries was studied. Consequently, there may be significant differences in case of studying samples from remote regions. It is necessary to search for ways to solve the problem of deteriorating vision among the population of the Russian Federation, especially among children.

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Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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