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A National Registry-Based Epidemiological Study to Evaluate 395 646 Patients Hospitalized Due to Eye Diseases in Poland in 2019

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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Conflict of interest:

This study was carried out as a part of the research project entitled “Poles’ attitudes towards eye diseases – knowledge about eye diseases, awareness of risk factors, prevention” led by the Faculty of Medicine, Collegium Medicum, Cardinal Stefan Wyszyński University and the School of Public Health, Centre of Postgraduate Medical Education, Warsaw, Poland

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None declared

None declared

Background:

The Nationwide General Hospital Morbidity Study Registry collects demographic, health, and medical data on patients hospitalized throughout Poland, and acts as a registry for epidemiological, public health, and hospital administrative studies. This epidemiological national registry-based study aimed to evaluate the characteristics of 395 646 patients hospitalized due to eye diseases in Poland in 2019.

Material/Methods:

This study is a retrospective nationwide registry-based analysis. Data on all patients hospitalized due to eye diseases in 2019 were obtained from the Nationwide General Hospital Morbidity Study Registry. Demographic characteristics of patients hospitalized due to eye diseases as well as the hospitalization course were analyzed using descriptive epidemiology tools.

Results:

Disorders of the lens accounted for 68.6% of all hospital admissions, and disorders of the choroid and retina were the second most common (13.9%) cause of hospital admission due to eye diseases in 2019. Over three-quarters of hospital admissions (77.4%) lasted less than 24 h, and 86.8% were scheduled admissions. Most of the patients hospitalized due to eye diseases were females (59.9%) and over 70% lived in urban areas. There were regional differences in the hospital admissions rate per 100 000 inhabitants. According to the data presented in the registry, less than one-third of patients had comorbidities.

Conclusions:

Hospital ophthalmological care in Poland is based mainly on planned hospitalizations lasting less than 24 h and related to ophthalmological surgery. Data on the comorbidity of ophthalmologic patients suggest that ophthalmologists do not pay enough attention to identifying and recording the patient’s health status.

Keywords:

Cataract • Eye Diseases • Hospitalization • Macular Degeneration • Poland • Registries


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Background

According to World Health Organization (WHO) estimates, over 2 billion people globally have vision impairment, of which 1 billion could have been prevented or have yet to be addressed [1,2]. The leading causes of vision impairment are uncorrected refractive errors or age-related eye diseases, including cataracts, age-related macular degeneration (AMD), glaucoma, and diabetic retinopathy [1-3]. A substantial variation in the causes of vision impairment within countries was observed. The proportion of vision impairment attributable to cataracts is higher in low- or middle-income countries, while glaucoma or AMD is more common in high-income countries [2,4].

Most cases of vision impairment occur in people aged 50 years and older [2,5]. Demographic changes, aging of the population (including longer life expectancy), and lifestyle changes are the most important factors that will lead to an increased incidence of vision impairment in the next decade [5,6]. Age-related changes in the ocular surface and corneal tissues affect vision and cause major eye diseases [7]. Lower-quality foods, low physical activity levels, and tobacco use are the most important lifestyle factors associated with increased risk for visual impairment [6]. Decreased visual acuity can significantly affect the quality of life in patients with eye diseases [8,9]. Moreover, major eye diseases like cataracts, AMD, and diabetic retinopathy are associated with increased mortality risk [10]. Vision impairment can also lead to functional disability, reduced social interaction, and increased risk of falls, accidents, and fractures [6,11,12]. Vision impairment also affects the individual's workforce participation and productivity [13]. The global financial burden due to productivity losses from vision impairment is estimated at 411 billion US dollars [13].

Due to the social burden of vision impairments and its economic consequences, numerous strategies to address eye conditions have been implemented globally [14], but most focused on providing timely access to healthcare and eye care services [2,14]. A significant proportion of refractive error can be corrected with eyeglasses or contact lenses [2-4]. However, age-related eye disease often requires eye surgery. Cataract surgery is one of the most cost-effective healthcare interventions [15].

Providing access to eye health services is crucial to reduce the burden of visual impairment. However, the availability of eye care services differs among countries [16]. The upcoming demographic and social changes will increase demands for eye health services [4,5,14]. Low- and middle-income countries may learn from high-income countries how to develop eye health services. Moreover, differences in the organization of health care in particular countries may also affect eye health services utilization [17].

Poland is an example of a European Union (EU) country that moved from being a middle- to a high-income country in less than 15 years [18]. A relatively large national income increase leads to social changes and a life expectancy increase [19]. In the Polish health system, mandatory health insurance provides access to a variety of health care services [20]. According to the data of the Supreme Medical Council, as of 30 November 2022 a total number of 4842 ophthalmologists provided medical services in Poland [21]. Eye health services are mostly provided in outpatient clinics [14,17]. However, eye surgery (eg, cataract surgery) is provided in dedicated hospital wards (ophthalmology departments) or single-profile ophthalmology hospitals [15,17]. Patients requiring eye surgery are admitted to the hospital, usually for less than 24 h, and are discharged the same day [22]. Regular monitoring of health services is necessary to evaluate and improve eye health care [23]. Moreover, characteristics of hospital eye care in countries such as Poland can be the basis for comparisons for countries with a similar demographic situation and can be the basis for healthcare resource planning, especially in the face of challenges resulting from population aging [24]. Data from the United States [25], England, and Wales [26] showed that national hospital registries may be used for epidemiological analyses of eye-related hospital admissions. In Poland, data on hospitalizations are collected by the Nationwide General Hospital Morbidity Study Registry [27], but there has been a lack of nationwide data on hospitalization due to eye diseases in Poland.

Therefore, this epidemiological national registry-based study aimed to evaluate the characteristics of 395 646 patients hospitalized due to eye diseases in Poland in 2019.

Material and Methods

Ethics

The study protocol was reviewed and approved by the Ethics Committee at the Centre of Postgraduate Medical Education (Warsaw, Poland), decision number 154/2022, November 16, 2022. This was a retrospective analysis of the Nationwide General Hospital Morbidity Study Registry, so datasets were anonymous and patient consent was waived.

Data source

This study was a retrospective nationwide registry-based analysis. Data on patients hospitalized due to eye diseases were obtained from the Nationwide General Hospital Morbidity Study Registry [27], managed by the Department of Population Health Monitoring and Analysis, National Institute of Public Health – National Institute of Hygiene (Warsaw, Poland). Data were gathered under the official Statistical Research Program

of Public Statistics [28]. All hospitals (both public and private facilities) operating in Poland (with some exceptions for psychiatric departments) are legally obligated to report data on hospitalizations. Data are reported using a standard template ensuring patients' anonymity [27]. Data are verified by trained public health specialists tasked with managing the registry, and are aggregated and analyzed for purposes such as healthcare planning and public statistics.

Data Reporting Methods

Data on patients hospitalized in Poland are reported using a template covering the following range of data: (1) sex (male/female); (2) age; (3) place of residence; (4) type of hospital and location; (5) cause of hospitalization; (6) co-existing diseases (comorbidities); (7) duration of hospitalization and detailed information on the type of wards and potential transfer to another ward during the hospitalization; (8) type of admission (emergency/scheduled); (9) medical services provided during the hospitalization; and (10) hospitalization outcome (death/discharge/transfer for further treatment).

Data on medical conditions and diagnoses are reported by trained physicians using the 10th revision of the International Statistical Classification of Diseases and Related Health Problems ICD-10 classification (ICD-10 codes) [29].

Patients hospitalized due to eye diseases were identified using ICD-10 codes: H00-H59 [29]. All the patients with primary diagnosis (cause of hospitalization) reported by a doctor using codes H00-H59 were included in this analysis. Based on the primary diagnosis, patients were assigned into one of the following groups of eye diseases: H00-H05 – disorders of the eyelid, lacrimal system, and orbit; H10-H11 – disorders of conjunctiva; H15-H22 – disorders of sclera, cornea, iris and ciliary body; H25-H28 – disorders of the lens; H30-H36 – disorders of choroid and retina; H40-H42 – glaucoma; H43-H44 – disorders of vitreous body and globe; H46-H47 – disorders of the optic nerve and visual pathways; H49-H52 – disorders of ocular muscles, binocular movement, accommodation, and refraction; H53-H54 – visual disturbances and blindness; and H55-H59 – other disorders of eye and adnexa [29].

The following ICD-10 codes were used to identify patients with selected eye diseases: (1) H25.0-H25.9 – age-related nuclear cataract; H26.2 – complicated cataract; and H35.3 – age-related macular degeneration (AMD) [29].

Data from the Nationwide General Hospital Morbidity Study Registry were previously used for nationwide analyses on COVID-19 and diabetes, published in peer-reviewed journals [30,31].

Data on the demographic characteristics of the Polish population were obtained from an official demographic registry regularly published by Statistics Poland [32].

Statistical Analysis

The data were analyzed with MS Excel (USA: Microsoft Corporation, Redmond, WA) and SPSS v.28 (USA: IBM, Armonk, NY). Epidemiological characteristics of patients hospitalized due to eye diseases were presented using descriptive statistics. Hospital admissions per 100 000 inhabitants were calculated based on the demographic data (sex, age, place of residence – administrative region) from Statistics Poland. The following age groups were included in the analysis: 0-17 (children), 18-29; 30-39; 40-49; 50-59; 60-69; 70-79; and 80 and over years. Epidemiological characteristics of patients hospitalized due to eye diseases were provided separately for a major group of diseases based on ICD-10 codes, as well as for the most common causes of hospitalization (cataract and AMD).

Results

Hospitalizations Due to Eye Diseases Between January and December 2019 in Poland

In 2019, a total of 395 646 hospital admissions due to eye conditions and diseases were reported in the Nationwide General Hospital Morbidity Study Registry. The highest numbers of hospitalizations due to eye diseases was reported in October (38 507) and May (35 650), while the lowest numbers were reported in February (29 839) and (27 629) December (**Figure 1**). There were regional differences in the hospital admissions rate per 100 000 inhabitants (**Table 1**). Out of 16 administrative regions (voivodships) in Poland, the highest hospital admissions rate per 100 000 inhabitants was in Lower Silesia (1331.6 hospital admissions per 100 000 inhabitants) and Silesia region (1322.9 hospital admissions per 100 000 inhabitants), and the lowest were in Pomerania (756.7 hospital admissions per 100 000 inhabitants) and Warmia-Masuria (740.7 hospital admissions per 100 000 inhabitants) (**Table 1**).

Causes of Hospital Admissions Due to Diseases of the Eye and Adnexa (H00-H59)

The most common causes for hospital admissions were: other age-related cataracts (code H25.8; n=130 624; 33.0%), complicated cataracts (code H26.2; n=56 892; 14.4%), age-related nuclear cataract (code H25.1; n=42 519; 10.7%); age-related incipient cataract (code H25.0; n=18 318; 4.6%); degeneration of macula and posterior pole (code H35.3; n=23 677; 6.0%); and other specified retinal disorders (code H35.8; n=12 785; n=3.2%). Disorders of the lens (codes H25-H28) accounted for

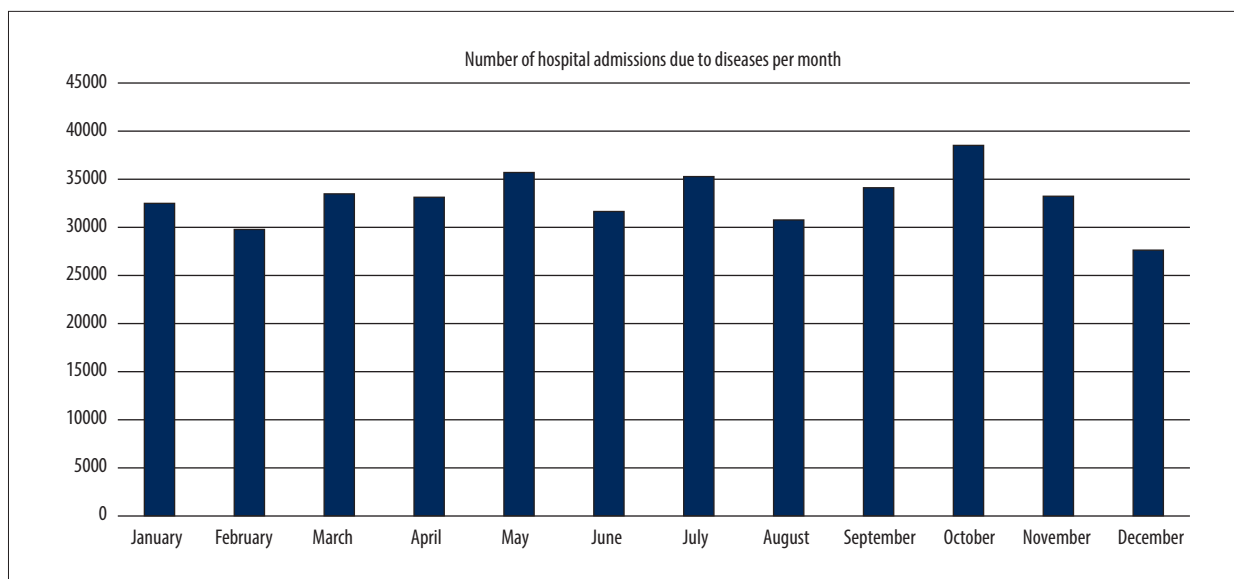


Figure 1. Number of hospital admissions due to eye diseases per month, January-December 2019.

Table 1. Regional differences in hospital admissions due to eye diseases (H00-H59) in Poland, January–December 2019.

Voivodeship	Number of hospital admissions	Hospital admissions per 100 000 inhabitants	Percentage of total admissions
Lower Silesia	38597	1331.6	9.8
Kuyavia-Pomerania	26399	1275.8	6.7
Lublin	22621	1075.5	5.7
Lubusz	9814	971.5	2.5
Lodzkie	28814	1176.7	7.3
Lesser Poland	26676	781.4	6.7
Masovia	57081	1051.6	14.4
Opole	9402	958.6	2.4
Subcarpathia	19621	922.9	5.0
Podlaskie	10677	907.5	2.7
Pomerania	17758	756.7	4.5
Silesia	59638	1322.9	15.1
Świętokrzyskie	11678	949.4	3.0
Warmia-Masuria	10522	740.7	2.7
Greater Poland	29707	848.7	7.5
West Pomerania	16641	982.8	4.2
Total	395646	1031.6	100.0

Table 2. Causes of hospital admissions due to diseases of the eye and adnexa (H00-H59) in Poland, January–December 2019.

The 10 th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) codes	Number of hospital admissions	Hospital admissions per 100 000 inhabitants	Percentage of total admissions
H00-H05 Disorders of eyelid, lacrimal system and orbit	17541	45.7	4.4
H10-H11 Disorders of conjunctiva	10515	27.4	2.7
H15-H22 Disorders of sclera, cornea, iris and ciliary body	10250	26.7	2.6
H25-H28 Disorders of lens	271468	707.8	68.6
H30-H36 Disorders of choroid and retina	54984	143.4	13.9
H40-H42 Glaucoma	9736	25.4	2.5
H43-H44 Disorders of vitreous body and globe	4111	10.7	1.0
H46-H47 Disorders of optic nerve and visual pathways	2033	5.3	0.5
H49-H52 Disorders of ocular muscles, binocular movement, accommodation and refraction	7454	19.4	1.9
H53-H54 Visual disturbances and blindness	3937	10.3	1.0
H55-H59 Other disorders of eye and adnexa	3617	9.4	0.9

68.6% of all hospital admissions due to eye diseases in 2019 in Poland (Table 2). Disorders of the choroid and retina (H30-H36) were the second most common (13.9% of total hospitalizations due to eye diseases) cause of hospital admission due to eye diseases in 2019. Hospital admissions rate per 100 000 inhabitants varied from 707.8 for disorders of the lens to 5.3 for disorders of the optic nerve and visual pathways (Table 2).

Over three-quarters of hospital admissions (77.4%) were 1-day admission (less than 24 h), and 86.8% were scheduled admissions (Table 3). Most of the patients hospitalized due to eye diseases in Poland were females (59.9%) and over 70% lived in urban areas. There were differences in duration of hospitalization, type of admissions, sex, and place of residence by cause of admission. Over 90% of patients hospitalized due to disorders of conjunctiva were hospitalized for less than 24 h, but only 14.7% of patients hospitalized due to disorders of the optic nerve and visual pathways were hospitalized for less than 24 h (Table 3). Over 80% of patients hospitalized due to disorders of the conjunctiva or disorders of the sclera, cornea, iris, and the ciliary body were admitted in emergency mode (Table 3). Out of 11 different groups of eye diseases, most of the patients hospitalized due to disorders of the

conjunctiva (52.0%), disorders of the sclera, cornea, iris, and ciliary body (53.3%), disorders of the vitreous body and globe (51.5%), and other disorders of eye and adnexa (56.3%; code H55-H59) were males (Table 3). Regardless of the cause of hospital admission, most of the patients lived in urban areas.

Out of 395 646 hospital admissions due to eye diseases in Poland, only 4.1% were among children (Table 4). Among adults hospitalized due to eye diseases, the hospitalization rate per 100 000 inhabitants increased with age – the hospitalization rate significantly increased after 50 years of age, and the highest hospitalization rate was observed among adults aged 70 years and over (Table 4).

Epidemiological Characteristics of Hospital Admissions Due to Cataract

Age-related nuclear cataract (H25.0-H25.9) was the most common cause of hospitalization, with 198 896 hospital admissions reported in 2019 (Table 5). Almost two-thirds of patients hospitalized due to age-related nuclear cataracts were females (63.8%). One-quarter of patients were aged 60-69 years, more than 40% were aged 70-79 years, and 28.8% were aged 80

Table 3. Epidemiological characteristics of hospital admissions due to diseases of the eye and adnexa (H00-H59) in Poland, January–December 2019.

The 10 th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) codes	Duration of hospitalization		Type of admission	
	<24 hours	At least 1 day	Emergency	Scheduled
Overall	306278 (77.4)	89368 (22.6)	52097 (13.2)	343549 (86.8)
H00-H05 Disorders of eyelid, lacrimal system and orbit	12823 (73.1)	4718 (26.9)	3817 (21.8)	13724 (78.2)
H10-H11 Disorders of conjunctiva	9614 (91.4)	901 (8.6)	8586 (81.7)	1929 (18.3)
H15-H22 Disorders of sclera, cornea, iris and ciliary body	5367 (52.4)	4883 (47.6)	8290 (80.9)	1960 (19.1)
H25-H28 Disorders of lens	229230 (84.4)	42238 (15.6)	12429 (4.6)	259039 (95.4)
H30-H36 Disorders of choroid and retina	39565 (72.0)	15419 (28.0)	8865 (16.1)	46119 (83.9)
H40-H42 Glaucoma	2407 (24.7)	7329 (75.3)	2999 (30.8)	6737 (69.2)
H43-H44 Disorders of vitreous body and globe	1218 (29.6)	2893 (70.4)	1434 (34.9)	2677 (65.1)
H46-H47 Disorders of optic nerve and visual pathways	299 (14.7)	1734 (85.3)	1298 (63.8)	735 (36.2)
H49-H52 Disorders of ocular muscles, binocular movement, accommodation and refraction	2069 (27.8)	5385 (72.2)	365 (4.9)	7089 (95.1)
H53-H54 Visual disturbances and blindness	1565 (39.8)	2372 (60.2)	1831 (46.5)	2106 (53.5)
H55-H59 Other disorders of eye and adnexa	2121 (58.6)	1496 (41.4)	2183 (60.4)	1434 (39.6)
The 10 th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) codes	Gender		Place of residence	
	Male	Female	Rural	Urban
Overall	158657 (40.1)	236989 (59.9)	117272 (29.6)	278374 (70.4)
H00-H05 Disorders of eyelid, lacrimal system and orbit	6712 (38.3)	10829 (61.7)	5044 (28.8)	12497 (71.2)
H10-H11 Disorders of conjunctiva	5470 (52.0)	5045 (48.0)	3416 (32.5)	7099 (67.5)
H15-H22 Disorders of sclera, cornea, iris and ciliary body	5462 (53.3)	4788 (46.7)	3502 (34.2)	6748 (65.8)
H25-H28 Disorders of lens	100124 (36.9)	171344 (63.1)	79291 (29.2)	192177 (70.8)
H30-H36 Disorders of choroid and retina	25893 (47.1)	29091 (52.9)	16032 (29.2)	38952 (70.8)
H40-H42 Glaucoma	4526 (46.5)	5210 (53.5)	2854 (29.3)	6882 (70.7)
H43-H44 Disorders of vitreous body and globe	2116 (51.5)	1995 (48.5)	1391 (33.8)	2720 (66.2)
H46-H47 Disorders of optic nerve and visual pathways	918 (45.2)	1115 (54.8)	666 (32.8)	1367 (67.2)

Table 3 continued. Epidemiological characteristics of hospital admissions due to diseases of the eye and adnexa (H00-H59) in Poland, January–December 2019.

The 10 th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) codes	Gender		Place of residence	
	Male	Female	Rural	Urban
H49-H52 Disorders of ocular muscles, binocular movement, accommodation and refraction	3584 (48.1)	3870 (51.9)	2501 (33.6)	4953 (66.4)
H53-H54 Visual disturbances and blindness	1814 (46.1)	2123 (53.9)	1372 (34.8)	2565 (65.2)
H55-H59 Other disorders of eye and adnexa	2038 (56.3)	1579 (43.7)	1203 (33.3)	2414 (66.7)

years or over (Table 5). Over 95% of hospitalizations due to age-related nuclear cataracts were scheduled admissions and 86.6% of hospitalizations lasted less than 24 h. Over 90% of patients stayed in the ophthalmology department. According to the data presented in the registry, only 28.6% of patients had comorbidities (Table 5).

The second most common cause of hospital admissions was complicated cataracts (H26.2), with 56 892 hospital admissions in 2019 (Table 5). Epidemiological characteristics of patients hospitalized due to complicated cataracts were comparable to those hospitalized due to age-related nuclear cataracts, except for the presence of comorbidities, which was 2 times higher among those with complicated cataracts (61.8% vs 28.6%). Moreover, 78.1% of patients hospitalized due to complicated cataracts were referred for further treatment in outpatient clinics compared to 70.9% of patients with age-related nuclear cataracts (Table 5).

Epidemiological Characteristics of Hospital Admissions Due to Age-Related Macular Degeneration (AMD)

The third most common cause of hospital admissions was degeneration of the macula and posterior pole, mostly used as a medical code for age-related macular degeneration (AMD). In 2019, a total of 23 677 hospital admissions due to AMD were reported (Table 6). More than half of patients hospitalized due to AMD were females (58.3%) and almost 90% of hospitalized patients were aged 60 years and over. Three-quarters of patients hospitalized due to AMD lived in urban areas. Over 90% of hospitalizations due to AMD were scheduled admissions, mostly to the ophthalmology department (96.2%). According to the data presented in the registry, only 29.0% of patients had comorbidities (Table 6).

Discussion

This registry-based study provides a comprehensive summary and analysis of epidemiological characteristics of 395 646

patients hospitalized due to eye diseases in Poland. Major causes of hospital admissions due to eye diseases were identified and the demographic characteristics of patients were provided. Over 60% of hospital admissions due to eye diseases were attributed to cataract surgery. A detailed analysis of the hospitalization course, including its duration and type of admission, was described in this study. This study also revealed that there is an urgent need to improve the quality of data reporting (especially related to patients' comorbidities) by physicians providing 1-day surgery medical services.

Public registries may provide a comprehensive overview of the medical services offered by health systems in particular countries. In Poland, eye health services are provided by outpatient clinics as well as ophthalmologic wards or single-profile ophthalmologic hospitals [33]. Most patients with vision impairment visit outpatient clinics, but those with acute injuries or chronic age-related eye diseases may require surgery. According to Polish law, ophthalmologic surgery is mostly provided in hospitals, but within 1-day surgery department/hospitalization. For example, a patient is admitted to the hospital in the morning and discharged home several hours after the surgery (mostly in the afternoon of the same day). However, in other countries ophthalmologic surgery may be provided on an outpatient basis, depending on the local health system.

Public registries were used for epidemiological analyses on hospitalizations due to eye diseases in England and Wales [26] as well as in the United States [25]. Between 1999 and 2019, the hospital admission rate for diseases of the eye and adnexa increased in England and Wales increased by 73.8% [26]. The hospital admission rate due to eye diseases increased by 91.2% among males and 63.2% among females [26]. In a study from England and Wales, the most common causes of hospitalization due to eye diseases were disorders of the lens (62.3%), disorders of the choroid and retina (14.2%), and disorders of the eyelid, lacrimal system, and orbit (11.5%) [26]. Similar epidemiological trends were observed in this study. In 2019 in Poland, 68.6% of hospital admissions due to eye diseases were

Table 4. Hospital admissions due to diseases of the eye and adnexa (H00-H59) by age groups in Poland, January–December 2019.

		Age groups							
		0-17	18-29	30-39	40-49	50-59	60-69	70-79	80+
	n	16310	6094	7935	11542	25358	95132	140154	93121
Overall	Rate per 100 000	234.7	115.4	129.1	204.9	543.0	1822.7	5018.3	5504.5
	n	3376	636	845	1390	2212	4007	3214	1861
H00-H05 Disorders of eyelid, lacrimal system and orbit	Rate per 100 000	48.6	12.0	13.8	24.7	47.4	76.8	115.1	110.0
	n	2089	1161	1458	1212	1209	1738	1117	531
H10-H11 Disorders of conjunctiva	Rate per 100 000	30.1	22.0	23.7	21.5	25.9	33.3	40.0	31.4
	n	836	1308	1611	1316	1123	1642	1288	1126
H15-H22 Disorders of sclera, cornea, iris and ciliary body	Rate per 100 000	12.0	24.8	26.2	23.4	24.0	31.5	46.1	66.6
	n	320	353	802	3089	12211	65945	112326	76422
H25-H28 Disorders of lens	Rate per 100 000	4.6	6.7	13.1	54.8	261.5	1263.5	4021.9	4517.4
	n	986	790	1411	2474	5822	15965	17147	10389
H30-H36 Disorders of choroid and retina	Rate per 100 000	14.2	15.0	23.0	43.9	124.7	305.9	614.0	614.1
	n	566	204	289	603	1047	2707	2743	1577
H40-H42 Glaucoma	Rate per 100 000	8.1	3.9	4.7	10.7	22.4	51.9	98.2	93.2
	n	400	116	140	246	532	1257	929	491
H43-H44 Disorders of vitreous body and globe	Rate per 100 000	5.8	2.2	2.3	4.4	11.4	24.1	33.3	29.0
	n	624	284	223	210	169	288	161	74
H46-H47 Disorders of optic nerve and visual pathways	Rate per 100 000	9.0	5.4	3.6	3.7	3.6	5.5	5.8	4.4
	n	5633	586	428	318	198	189	82	20
H49-H52 Disorders of ocular muscles, Binocular movement, Accommodation and refraction	Rate per 100 000	81.1	11.1	7.0	5.6	4.2	3.6	2.9	1.2
	n	903	278	311	267	401	755	659	363
H53-H54 Visual disturbances and blindness	Rate per 100 000	13.0	5.3	5.1	4.7	8.6	14.5	23.6	21.5
	n	577	378	417	417	434	639	488	267
H55-H59 Other disorders of eye and adnexa	Rate per 100 000	8.3	7.2	6.8	7.4	9.3	12.2	17.5	15.8

Table 5. Epidemiological characteristics of 254 788 hospital admissions due to cataract in Poland, January–December 2019.

Variable	Hospital admissions due to cataract			
	Age-related nuclear cataract* n=197 896		Complicated cataract** n=56 892	
	n	%	n	%
Gender				
Male	71 713	36.2	20 875	36.7
Female	126 183	63.8	36 017	63.3
Age group				
0-17	0	0.0	29	0.1
18-29	0	0.0	88	0.2
30-39	19	0.0	210	0.4
40-49	1180	0.6	682	1.2
50-59	6585	3.3	2478	4.4
60-69	48 792	24.7	13 591	23.9
70-79	84 237	42.6	23 639	41.6
80+	57 083	28.8	16 175	28.4
Place of residence				
Rural	58 658	29.6	15 349	27.0
Urban	139 238	70.4	41 543	73.0
Presence of comorbidities according to discharge card				
Yes	56 536	28.6	35 132	61.8
No	141 360	71.4	21 760	38.2
Type of admission				
Emergency	9288	4.7	2040	3.6
Scheduled	188 608	95.3	54 852	96.4
Duration of hospitalization				
<24 hours	171 409	86.6	45 280	79.6
1 day	16 800	8.5	7523	13.2
2 days	7551	3.8	2910	5.1
3 days or more	2136	1.1	1179	2.1
Number of hospital wards				
1	197 814	99.9	56 863	99.9
2 or more	82	0.1	29	0.1
Hospital ward				
Ophthalmology	179 792	90.9	54 208	95.3
One-day Surgery Department	10 680	5.4	1752	3.1

Table 5 continued. Epidemiological characteristics of 254 788 hospital admissions due to cataract in Poland, January–December 2019.

Variable	Hospital admissions due to cataract			
	Age-related nuclear cataract* n=197 896		Complicated cataract** n=56 892	
	n	%	n	%
Emergency Department	1388	0.8	70	0.1
Other wards	6036	2.9	862	1.5
Outcome of hospitalization				
Completion of the therapeutic or diagnostic process	57 665	29.1	12 471	21.9
Referral for further treatment in the outpatient clinic	140 231	70.9	44 421	78.1

caused by disorders of the lens and 13.9% were caused by disorders of the choroid and retina. However, only 4.4% of hospital admissions were caused by disorders of the eyelid, lacrimal system, and orbit, which is 2.5 times lower than in England and Wales [26]. Between 2006 and 2011, a total of 11.9 million emergency department visits for eye problems were reported in the United States [25], of which 44.3% were nonemergent problems [25]. Female sex, lower income, and younger age were significantly associated with emergency department visits for nonemergent eye problems in the United States [25]. In this study, only 13.2% of hospital admissions due to eye diseases were emergency admissions. Between 2006 and 2011 in the United States, more than 4 million emergency department visits occurred for conjunctivitis, subconjunctival hemorrhages, and stye [25]. In this study, most of the hospitalizations due to disorders of the conjunctiva (81.7%) were emergency admission, which is in line with the data from the United States. Moreover, in this study, over 80% of hospital admissions due to disorders of the sclera, cornea, iris, and ciliary body were also emergency admissions. National registries may be a valuable data source for the international comparison of eye care.

In 2019, the major cause of eye-related hospitalizations in Poland was disorders of the lens, responsible for over two-thirds of hospital admissions. Cataracts remain one of the leading causes of blindness [3,4]. Cataract surgery is a fast and cost-effective intervention with rapid visual recovery and good visual outcomes [34]. Findings from this study showed that most patients hospitalized due to cataracts were females and >90% of patients were aged 60 years and over. This is in line with the global data on cataract epidemiology [35]. Disorders of the choroid and retina (mainly AMD) were the second most common cause of hospitalization. AMD is a growing eye health problem in developed countries, mostly due to population aging and lifestyle factors associated with the development of AMD, like smoking, and low dietary intake of antioxidants [36]. The

number of patients hospitalized due to AMD may increase because of socio-economic changes in Poland [18]. Characteristics of the major causes of ophthalmological hospitalizations presented in this study can be used by other countries (mostly developing countries) to estimate further eye healthcare needs.

In 2019, every month approximately 30 000 patients were admitted to the hospital due to eye diseases, except the December, when the number of hospital admissions due to eye diseases reached 27 629 admissions. This drop may result from the fact that the winter season and Christmas can affect patients' willingness to visit a doctor. In the case of many ophthalmological procedures financed from public funds, medical facilities have a limit on the number of performed procedures each year [20]. However, in April 2019, the limits on cataract procedures financed from public funds were lifted, and facilities could perform the procedure on any patient who met the indications for surgery. Monthly differences in eye healthcare utilization require further investigation.

In this study, regional differences in hospital admission rates per 100 000 inhabitants were noticed. Eye care services in Poland are provided by less than 5000 ophthalmologists [21], so the limited number of healthcare workers may be a major barrier to eye health care. Vision care inequity is a relatively common phenomenon, observed also in high-income countries like the USA [37]. In addition to the organization of healthcare, other important factors affecting the utilization of eye healthcare include financial, logistics, and awareness barriers [37]. In this study, 30% of patients hospitalized due to eye diseases lived in rural areas. It is estimated that 40% of Poles live in rural areas [32]. Ophthalmologic departments are located mostly in medium-size or large cities, so we cannot exclude that some patients living in rural areas may face transportation barriers to accessing eye health care [38], but this hypothesis requires further investigation.

Table 6. Epidemiological characteristics of 23 677 hospital admissions (H35.3) due to age-related macular degeneration (AMD) in Poland, January–December 2019.

Variable	Hospital admissions due to age-related macular degeneration (AMD)* n=23 677	
	n	%
Gender		
Male	9885	41.7
Female	13 792	58.3
Age group		
0-17	18	0.1
18-29	96	0.4
30-39	258	1.1
40-49	474	2.0
50-59	1601	6.8
60-69	5635	23.8
70-79	8610	36.4
80+	6985	29.5
Place of residence		
Rural	5861	24.8
Urban	17 816	75.2
Presence of comorbidities according to discharge card		
Yes	6859	29.0
No	16 819	71.0
Type of admission		
Emergency	1505	6.4
Scheduled	22 172	93.6
Duration of hospitalization		
<24 hours	21 672	91.5
1 day	840	3.5
2 days	959	4.1
3 days or more	206	0.9
Number of hospital wards		
1	23 644	99.9
2 or more	33	0.1
Hospital ward		
Ophthalmology	22 775	96.2
One-day Surgery Department	79	0.3

Table 6 continued. Epidemiological characteristics of 23 677 hospital admissions (H35.3) due to age-related macular degeneration (AMD) in Poland, January–December 2019.

Variable	Hospital admissions due to age-related macular degeneration (AMD)* n=23 677	
	n	%
Emergency Department	679	2.9
Other wards	144	0.6
Outcome of hospitalization		
Completion of the therapeutic or diagnostic process	9059	38.3
Referral for further treatment in the outpatient clinic	14 618	61.7

National data on the duration of hospitalization and type of admissions presented in this study, especially in particular health indications (ICD-10 codes), may be used as a benchmark for ophthalmology departments and hospitals. Length of stay is a commonly used measure for quality of care [39]. In this study, the duration of hospitalization differed by cause of admission. Most of the patients were hospitalized for less than 24 h. Only 5% of patients hospitalized due to cataracts were hospitalized for 2 days. This finding may be used to evaluate the quality of eye care in medical facilities with longer lengths of stay.

Age is a significant risk factor for eye diseases [1-4]. Eye diseases can occur at any age, but most of them are age-related and start after 40 years of age. The findings from this study are in line with the global data on aging and eye diseases [3-5]. In this study, a significant peak of hospitalizations was observed between patients aged 50-59 and 60-69 years. This observation suggests that eye disease screening programs should pay particular attention to those aged 50-60 years, especially those who currently work. Out of all hospitalizations due to eye diseases reported in 2019, only 4.1% were among children. The most common cause of hospital admissions among children were disorders of the eyelid, lacrimal system, and orbit (20.7% of all pediatric hospitalizations due to eye diseases). In addition to congenital eye and adnexa disorders, injuries and acute inflammations are also common causes of hospitalization among children. Nevertheless, vision screening programs are needed to identify vision impairments among children [40]. In Poland, vision screening is a part of the regular medical check-ups provided by general practitioners. ICD-10 code H35.3 is used for AMD diagnosis, but this code also includes “degeneration of macula and posterior pole” [29]. It may be that younger patients (especially those aged 30 and below) admitted to the hospital due to eye diseases defined using code H35.3 have other degeneration of the macula and posterior pole, rather than AMD. However, there were only 114 patients under 30 years of age hospitalized with the H35.3 diagnostic code.

As data on underlying conditions (comorbidities) are reported to the Polish National Hospital Register, an attempt to provide characteristics of comorbidities among patients hospitalized due to eye diseases was carried out. However, the prevalence of chronic diseases was 28.6% among patients with age-related cataracts and 29.0% among patients with AMD. As most of the patients were over 60 years old and age is a significant risk factor for chronic diseases [41], this finding suggests that numerous physicians miss data on co-existing diseases among patients hospitalized due to eye diseases. Most eye surgeries are low-invasive, and patients can leave the hospital on the same day, so ophthalmologists might miss comorbidities in discharge records. High-quality data are necessary to develop public health policies, so physicians who performed 1-day surgery should pay more attention to medical documentation.

There are numerous practical implications resulting from this study. Epidemiological characteristics of patients hospitalized due to eye diseases may be used by clinicians to monitor and evaluate eye disease management in Poland. Moreover, data presented in this study may be used as a benchmark for ophthalmological wards in Poland. Policymakers tasked with the organization of healthcare in Poland may use the presented data to plan further improvements in the health policy related to eye diseases. Regional differences in the hospitalization rate due to eye diseases presented in this study underline the need to reduce regional gaps in access to ophthalmological care. Moreover, data on causes of hospitalizations in different age groups may be used by healthcare professionals during the implementation of eye disease prevention programs.

The following limitations of this study should be underlined. First, this analysis is based on hospital admissions due to eye diseases. Data on patients visiting outpatient clinics were not included, so this study is limited to hospital-based ophthalmological care. Second, data on comorbidities should be analyzed carefully, as the prevalence of co-existing diseases reported

by ophthalmologists in discharge records is lower than that shown in the epidemiological data on the health status of the Polish population, especially among elderly patients with cataracts [42]. Therefore, sub-analysis based on the prevalence of chronic diseases such as diabetes or hypertension was missed. Third, data on surgical procedures and types of treatment was not included in this analysis.

Conclusions

This study showed that disorders of the lens are the major cause of hospitalizations due to eye diseases in Poland. Significant regional differences in the hospitalization rate were observed. Hospital ophthalmological care in Poland is based mainly on planned hospitalizations lasting less than 24 h and

related to ophthalmological surgery. Data on the comorbidity of ophthalmologic patients suggest that ophthalmologists do not pay enough attention to identifying and recording the patient's health status.

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Declaration of Figures' Authenticity

All figures submitted have been created by the authors, who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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