



# Factors associated with the frequency of eye examinations among adults in Poland – a nationwide cross-sectional survey, December 2022

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## Abstract

**Introduction and Objective.** The eye examination is a simple and effective intervention that involves a series of tests to evaluate vision and check for eye disease. This study aimed to assess the frequency of eye examinations among adults in Poland and to identify factors associated with the frequency of such examinations.

**Material and method.** The questionnaire-based cross-sectional survey was carried out in December 2022 on a non-probability quota sample of 1,076 adults in Poland. A computer-assisted web interview technique was used. The study questionnaire included a set of questions on eye health, eye examinations, and socio-demographic characteristics.

**Results.** Of the 1,076 respondents, 7.4% had an eye examination in the last 30 days, almost one-quarter (24.2%) had an eye examination more than 1 month but not more than 12 months ago, 13.9% had an eye examination in the last 1–2 years, and 24.1% had an eye examination more than 2 years ago but not more than 3 years ago. Among the respondents, 7.1% declared that they had never had an eye examination. Of the 12 different factors analyzed in this study, wearing spectacles or lenses and self-reported level of knowledge on eye diseases were the only factors significantly associated with higher odds of eye examinations in the last 12 months or 2 years. There was no significant impact of gender, educational level, place of residence, health status, or economic status ( $p > 0.05$ ) on the frequency of eye examinations, neither in the last 12 months nor in the last 2–3 years.

**Conclusions.** The study showed that a significant percentage of adults in Poland do not have regular eye examinations. There was a lack of socio-economic differences (including place of residence and economic status) in the frequency of eye examinations. There is an urgent need for health education on preventive eye examinations and eye care among adults in Poland.

## Key words

Poland, eye diseases, ophthalmology, vision screening, preventive medicine, vision impairment, eye examinations

## INTRODUCTION

Vision is the most dominant of the five human senses [1] and is integral to interpersonal and social interactions [2], as well as affects daily activities and the ability to work [3]. Moreover, vision is crucial for a child's social development and education [4]. The World Health Organization estimates that at least 2.2 billion people have vision impairments, wherein half of these cases could have been prevented or have yet to be addressed [4].

Vision impairment can be divided into two major groups: (1) those caused by refractive errors; and (2) those caused by eye conditions and diseases. Nearsightedness (myopia) is the most common refractive error [3]. Cataracts, diabetes retinopathy, glaucoma, and age-related macular degeneration are the most common eye diseases leading to vision impairment or blindness [3].

The eye examination is a simple and effective intervention that involves a series of tests to evaluate vision and check for eye disease [5, 6]. Eye examinations may be carried out by primary care doctors, ophthalmologists, optometrists, orthoptists, and other qualified healthcare professionals using a variety of techniques [5]. A regular eye examination is an essential element of a healthy lifestyle and secondary prevention of eye diseases [7]. Many eye diseases are asymptomatic or minimally symptomatic for a long time, therefore an eye examination is crucial for early diagnosis and effective treatment [8].

There are different types of eye examinations, the common goal of which is to assess eye health [5, 9]. Eye examinations may include the following tests: visual acuity test, refraction assessment, eye muscle test, visual field test (perimetry), colour vision testing, slit-lamp examination, ophthalmoscopy, tonometry measures, optic disc tests, optical coherent tomography (OCT) of optic nerve or macula, Amsler grid, ultrasonography and electrophysiology [5]. The scope of tests is determined individually and depends on age, health status (presence of chronic diseases, e.g., diabetes, hypertension), and eye condition. In general, routine screening (mostly

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based on visual acuity tests) is performed by primary healthcare professionals or ophthalmologists/optometrists/orthoptists, and comprehensive eye examination is carried out by ophthalmologists [5].

Vision impairment affects both the personal and societal health of children, because of which in many European countries vision screening programmes were launched [10]. However, an analysis of vision screening programmes in 35 European countries showed significant differences in the organization of such programmes, their funding, and the eligible population [10]. In most countries, vision screening is free and performed by paediatricians, ophthalmologists, and/or nurses [10]. Picture charts are the most common vision screening method in children aged three years, wherein the Tumbling-E eye chart and Snellen chart are commonly used in children over the age four years [10, 11]. Children with abnormal test results are often referred to ophthalmologists for a further comprehensive eye examination.

While there are vision screening guidelines for children, there is a lack of guidelines on the frequency and scope of eye examinations among adults [4]. Age is one of the most important risk factors for eye diseases [12] and it is estimated that 80% of vision impairment occurs in the age group of 50 and over [4, 12]. Moreover, chronic diseases, such as diabetes or lifestyle behaviours like smoking or poor-quality diet, are significant risk factors for eye diseases [13]. Individuals with refractive error (e.g., myopia) should also have their eyes checked regularly.

Eye care is not typically included in health strategic plans [4], and the frequency of eye screening among adults depends on the individual health behaviours or legal status in a given country [4, 10]. Poland is the European country with a children's vision screening programme [10]. The basic eye examination is performed by a paediatrician or general practitioner. The first eye examination is most often performed after the age of two years and is regularly repeated during childhood.

In general, adults in Poland are encouraged to have an eye examination at least every two years [14]. With the exception of voluntary eye examinations, some types of eye examinations are defined in law [15, 16]. The eye examination is often carried out as a part of occupational medicine [15]. All employees are obligated to have routine health check-ups (including eye examinations) every 2–4 years. Moreover, drivers are required to undergo eye tests at specified time intervals [17]. Financial, transportation (including place of residence), and health status are the most common barriers to accessing healthcare, including eye care [18]. During the COVID-19 pandemic, the time intervals for performing routine health check-ups under occupational medicine were extended. There is a lack of up-to-date national data on the frequency of eye examinations among adults in Poland. Moreover, factors associated with routine vision screening have not yet been studied.

## OBJECTIVE

The aim of the survey is to assess the frequency of eye examinations among adults in Poland and to identify factors associated with the frequency of eye examinations.

## MATERIALS AND METHOD

This cross-sectional survey was carried out in December 2022 on a representative sample of adults in Poland. The data collection process (computer-assisted web interview) was managed by a specialized survey company on behalf of the research team that provided the scientific context of the study [19]. A non-probability quota sample of 1,076 adults aged 18–83 in Poland was selected from the dataset of 100,000 users of a certified web survey research company [19]. The stratification model included three variables (gender, age, and place of residence) and based on the demographic characteristics of the Polish population, published by Statistics Poland – an official governmental agency in Warsaw, Poland [20]. A similar method was had been used in previously published nationwide studies carried out among adults in Poland [21, 22].

This study is a part of the research project entitled 'Poles' attitudes towards eye diseases – knowledge about eye diseases, awareness of risk factors, prevention'. A self-prepared questionnaire was used. A set of questions on public awareness of eye diseases, eye care, eye examination, and socio-economic characteristics were addressed. Respondents were asked about the frequency of eye examinations using the following question: 'Please indicate when you last performed an eye examination? with the following answer choices: 'in the last 30 days', 'more than one month but not more than 12 months ago', 'more than one year ago but not more than two years ago', 'more than two years ago but not more than three years ago', 'more than three years ago', or 'never'.

The approval of the Ethics Committee at the Centre of Postgraduate Medical Education was obtained (Decision No. 154/2022). Participation in the study was voluntary and anonymous.

The data were analyzed with SPSS Version 28 (IBM Corp., Armonk, New York, USA). The distribution of categorical variables was shown by the frequencies and proportions. Chi-squared test and cross-tabulation were used for bivariate analyses. Associations between socio-economic factors (independent variable) and (dependent variable): (1) eye examination in the last 12 months; (2) eye examination in the last two years; or (3) eye examination in the last three years were analyzed using multivariable logistic regression models. Odds ratio (OR) and 95% confidence intervals (CIs) were used to measure the strength of the association. The statistical significance level was set as  $p < 0.05$ .

## RESULTS

Data were received from 1,076 adults aged 18–83 years. Among the respondents, 54.2% were females, over one-third (37.5%) lived in rural areas and 55.2% of respondents declared that they had vision impairment that requires wearing spectacles or contact lenses. Table 1 shows the characteristics of the study population.

### Frequency of eye examinations by socio-economic factors.

Of the 1,076 respondents, 7.4% had an eye examination in the last 30 days, almost one-quarter (24.2%) had an eye examination more than one month but not more than 12 months ago, 13.9% had an eye examination in the last 1–2 years, almost one-quarter (24.1%) had an eye examination

more than two years ago but not more than 3 years ago (Tab. 2). Among the respondents, 7.1% declared that they had never had an eye examination.

There were significant differences ( $p < 0.05$ ) in the frequency of eye examinations by socio-economic factors, such as age group, educational level, marital status, having children, professional activity status, economic status, and the presence of chronic diseases (Tab. 2). Moreover, the frequency of eye examinations was higher among those who had vision impairment that required wearing spectacles or contact lenses, as well as among those who declared a good level of knowledge of eye diseases (Tab. 2). There were no differences in the frequency of eye examinations by gender or place of residence ( $p < 0.05$ ).

**Factors associated with eye examinations among adults in Poland.** The potential impact of 12 different factors on the frequency of eye examinations among adults in Poland was analyzed with logistic regression models (Tab. 3). In multivariable logistic regression analysis, out of 12 different variables only wearing spectacles or contact lenses (OR: 2.17, 95%CI: 1.64–2.87;  $p < 0.001$ ) and self-reported level of knowledge of eye diseases (good (OR: 2.35, 95%CI: 1.51–3.66;  $p < 0.001$ ) or moderate (OR: 1.59, 95%CI: 1.20–2.12;  $p = 0.001$ ) were significantly associated with higher odds of an eye examination in the last 12 months (Tab. 3). Also, wearing spectacles or contact lenses (OR: 2.71, 95%CI: 2.08–3.54;  $p < 0.001$ ) and self-reported level of knowledge of eye diseases (good (OR: 1.96, 95%CI: 1.24–3.10;  $p = 0.004$ ) or moderate (OR: 1.67, 95%CI: 1.208–2.18;  $p < 0.001$ ) were the only factors significantly associated with higher odds of an eye examination in the last two years (Tab. 3).

Moreover, in multivariable logistic regression analysis, respondents who were currently married (OR: 1.44, 95%CI: 1.04–2.01;  $p = 0.03$ ), currently employed or self-employed respondents (professionally active) (OR: 1.90, 95%CI: 1.36–2.65;  $p < 0.001$ ), those who had vision impairment that requires wearing spectacles or contact lenses (OR: 3.44, 95%CI: 2.57–4.60;  $p < 0.001$ ) as well as those who declared a moderate level of knowledge of eye diseases (OR: 1.73, 95%CI: 1.29–2.33;  $p < 0.001$ ) had higher odds of an eye examination in the last three years (Ta. 4). Respondents aged 30–39 years had lower odds (OR: 0.53, 95%CI: 0.34–0.83;  $p = 0.01$ ) of an eye examination in the last three years, compared to other age groups (Tab. 4).

There was no significant impact of gender, educational level, place of residence, health status, or economic status ( $p > 0.05$ ) on the frequency of eye examinations, neither in the last 12 months nor in the last 2–3 years (Tab. 3 and 4).

## DISCUSSION

This study presented a comprehensive characteristic of Poles' attitudes toward eye examinations. One-quarter of adults in Poland had an eye examination more than three years ago, and 7.1% had never had eye examinations. Wearing spectacles or contact lenses and a high level of knowledge of eye diseases were the most important factors associated with the frequency of eye examinations. There was no significant impact of gender, educational level, place of residence, health status, or economic status on the frequency of eye examinations. Findings from this study suggest that

**Table 1.** Characteristics of the study population (n=1076)

Variable	n	%
<b>Gender</b>		
male	493	45.8
female	583	54.2
<b>Age group (years)</b>		
18–29	219	20.4
30–39	211	19.6
40–49	186	17.3
50–59	199	18.5
60+	261	24.3
<b>Educational level</b>		
higher education	443	41.2
less than higher	633	58.8
<b>Currently married</b>		
yes	561	52.1
no	515	47.9
<b>Place of residence</b>		
rural area	403	37.5
city < 20,000 inhabitants	136	12.6
city ≥ 20,000 < 100,000 inhabitants	212	19.7
city ≥ 100,000 < 500,000 inhabitants	191	17.8
city ≥ 500,000 inhabitants	134	12.5
<b>Having children</b>		
yes	688	63.9
no	388	36.1
<b>Household size</b>		
living alone	148	13.8
2 persons	371	34.5
3 persons or more	557	51.8
<b>Professional activity</b>		
active	653	60.7
passive	423	39.3
<b>Economic status</b>		
good	414	38.5
moderate	408	37.9
bad	254	23.6
<b>Health status</b>		
healthy	598	55.6
presence of at least one chronic condition	478	44.4
<b>Wearing spectacles or contact lenses</b>		
yes	594	55.2
no	482	44.8
<b>Self-reported knowledge of eye diseases</b>		
good	107	9.9
moderate	471	43.8
bad	498	46.3

a significant proportion of adults in Poland do not pay attention to regular eye examinations, which may increase the burden of eye diseases.

In Poland, eye examinations are widely available in medical facilities and optic stores [23]. Primary care physicians or

**Table 2.** Frequency of eye examination by socio-economic factors, Poland 2022 (n=1092)

Frequency of vision screening by socio-economic factors													
Variable	In the last 30 days		More than 1 month, but not more than 12 months ago		More than 1 year ago, but not more than 2 years ago		More than 2 years ago, but not more than 3 years ago		More than 3 years ago		Never		p
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	
Overall	80	7.4	251	23.3	260	24.2	150	13.9	259	24.1	76	7.1	
Gender													
male	38	7.7 (5.7-10.4)	109	22.1 (18.7-26.0)	119	24.1 (20.6-28.1)	68	13.8 (11.0-17.1)	121	24.5 (21.0-28.5)	38	7.7 (5.7-10.4)	0.9
female	42	7.2 (5.4-9.6)	142	24.4 (21.1-28.0)	141	24.2 (20.9-27.8)	82	14.1 (11.5-17.1)	138	23.7 (20.4-27.3)	38	6.5 (4.8-8.8)	
Age group (years)													
18–29	21	9.6 (6.4-14.2)	41	18.7 (14.1-24.4)	47	21.5 (16.5-27.4)	33	15.1 (10.9-20.4)	51	23.3 (18.2-29.3)	26	11.9 (8.2-16.8)	
30–39	13	6.2 (3.6-10.3)	39	18.5 (13.8-24.3)	49	23.2 (18.0-29.4)	22	10.4 (7.0-15.3)	62	29.4 (23.7-35.9)	26	12.3 (8.6-17.4)	
40–49	11	5.9 (3.3-10.3)	48	25.8 (20.1-32.5)	51	27.4 (21.5-34.2)	25	13.4 (9.3-19.1)	38	20.4 (15.3-26.8)	13	7.0 (4.1-11.6)	<0.001
50–59	9	4.5 (2.4-8.4)	57	28.6 (22.8-35.3)	44	22.1 (16.9-28.4)	39	19.6 (14.7-25.7)	41	20.6 (15.6-26.8)	9	4.5 (2.4-8.4)	
60+	26	10.0 (6.9-14.2)	66	25.3 (20.4-30.9)	69	26.4 (21.5-32.1)	31	11.9 (8.5-16.4)	67	25.7 (20.8-31.3)	2	0.8 (0.2-2.8)	
Educational level													
higher education	36	8.1 (5.9-11.1)	111	25.1 (21.3-29.2)	117	26.4 (22.5-30.7)	65	14.7 (11.7-18.3)	100	22.6 (18.9-26.7)	14	3.2 (1.9-5.2)	<0.001
less than higher	44	7.0 (5.2-9.2)	140	22.1 (19.1-25.5)	143	22.6 (19.5-26.0)	85	13.4 (11.0-16.3)	159	25.1 (21.9-28.6)	62	9.8 (7.7-12.4)	
Currently married													
yes	41	7.3 (5.4-9.8)	147	26.2 (22.7-30.0)	145	25.8 (22.4-29.6)	81	14.4 (11.8-17.6)	123	21.9 (18.7-25.5)	24	4.3 (2.9-6.3)	<0.001
no	39	7.6 (5.6-10.2)	104	20.2 (17.0-23.9)	115	22.3 (19.0-26.1)	69	13.4 (10.7-16.6)	136	26.4 (22.8-30.4)	52	10.1 (7.8-13.0)	
Place of residence													
rural area	27	6.7 (4.6-9.6)	103	25.6 (21.5-30.0)	94	23.3 (19.5-27.7)	55	13.6 (10.6-17.3)	94	23.3 (19.5-27.7)	30	7.4 (5.3-10.4)	
city < 20,000 inhabitants	7	5.1 (2.5-10.2)	24	17.6 (12.2-24.9)	32	23.5 (17.2-31.3)	23	16.9 (11.5-24.1)	35	25.7 (19.1-33.7)	15	11.0 (6.8-17.4)	
city ≥ 20,000 < 100,000 inhabitants	18	8.5 (5.4-13.0)	51	24.1 (18.8-30.2)	58	27.4 (21.8-33.7)	26	12.3 (8.5-17.4)	48	22.6 (17.5-28.7)	11	5.2 (2.9-9.1)	0.8
city ≥ 100,000 < 500,000 inhabitants	18	9.4 (6.0-14.4)	40	20.9 (15.8-27.3)	49	25.7 (20.0-32.3)	28	14.7 (10.3-20.4)	45	23.6 (18.1-30.1)	11	5.8 (3.3-10.0)	
city ≥ 500,000 inhabitants	10	7.5 (4.1-13.2)	33	24.6 (18.1-32.6)	27	20.1 (14.2-27.7)	18	13.4 (8.7-20.2)	37	27.6 (20.8-35.7)	9	6.7 (3.6-12.3)	
Having children													
yes	54	7.8 (6.1-10.1)	173	25.1 (22.1-28.5)	171	24.9 (21.8-28.2)	99	14.4 (12.0-17.2)	160	23.3 (20.3-26.6)	31	4.5 (3.2-6.3)	<0.001
no	26	6.7 (4.6-9.6)	78	20.1 (16.4-24.4)	89	22.9 (19.0-27.4)	51	13.1 (10.1-16.9)	99	25.5 (21.4-30.1)	45	11.6 (8.8-15.2)	
Household size													
living alone	14	9.5 (5.7-15.3)	27	18.2 (12.9-25.2)	38	25.7 (19.3-33.3)	17	11.5 (7.3-17.6)	40	27.0 (20.5-34.7)	12	8.1 (4.7-13.6)	
2 persons	26	7.0 (4.8-10.1)	93	25.1 (20.9-29.7)	95	25.6 (21.4-30.3)	50	13.5 (10.4-17.3)	87	23.5 (19.4-28.0)	20	5.4 (3.5-8.2)	0.6
3 persons or more	40	7.2 (5.3-9.6)	131	23.5 (20.2-27.2)	127	22.8 (19.5-26.5)	83	14.9 (12.2-18.1)	132	23.7 (20.4-27.4)	44	7.9 (5.9-10.4)	
Professional activity													
active	39	6.0 (4.4-8.1)	160	24.5 (21.4-27.9)	173	26.5 (23.3-30.0)	97	14.9 (12.3-17.8)	134	20.5 (17.6-23.8)	50	7.7 (5.9-10.0)	0.001
passive	41	9.7 (7.2-12.9)	91	21.5 (17.9-25.7)	87	20.6 (17.0-24.7)	53	12.5 (9.7-16.0)	125	29.6 (25.4-34.1)	26	6.1 (4.2-8.9)	

## Frequency of vision screening by socio-economic factors

Variable	In the last 30 days		More than 1 month, but not more than 12 months ago		More than 1 year ago, but not more than 2 years ago		More than 2 years ago, but not more than 3 years ago		More than 3 years ago		Never		p
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	
<b>Economic status</b>													
good	35	8.5 (6.1-11.5)	102	24.6 (20.7-29.0)	112	27.1 (23.0-31.5)	47	11.4 (8.7-14.8)	87	21.0 (17.4-25.2)	31	7.5 (5.3-10.4)	0.03
moderate	34	8.3 (6.0-11.4)	90	22.1 (18.3-26.3)	85	20.8 (17.2-25.0)	72	17.6 (14.3-21.6)	97	23.8 (19.9-28.1)	30	7.4 (5.2-10.3)	
bad	11	4.3 (2.4-7.6)	59	23.2 (18.5-28.8)	63	24.8 (19.9-30.5)	31	12.2 (8.7-16.8)	75	29.5 (24.3-35.4)	15	5.9 (3.6-9.5)	
<b>Health status</b>													
healthy	34	5.7 (4.1-7.8)	133	22.2 (19.1-25.8)	146	24.4 (21.1-28.0)	88	14.7 (12.1-17.8)	140	23.4 (20.2-27.0)	57	9.5 (7.4-12.2)	0.02
presence of at least one chronic condition	46	9.6 (7.3-12.6)	118	24.7 (21.0-28.7)	114	23.8 (20.3-27.9)	62	13.0 (10.3-16.3)	119	24.9 (21.2-29.0)	19	4.0 (2.6-6.1)	
<b>Wearing spectacles or contact lenses</b>													
yes	61	10.3 (8.1-13.0)	168	28.3 (24.8-32.0)	166	27.9 (24.5-31.7)	86	14.5 (11.9-17.5)	106	17.8 (15.0-21.1)	7	1.2 (0.6-2.4)	<0.001
no	19	3.9 (2.5-6.1)	83	17.2 (14.1-20.9)	94	19.5 (16.2-23.3)	64	13.3 (10.5-16.6)	153	31.7 (27.8-36.0)	69	14.3 (11.5-17.7)	
<b>Self-reported knowledge of eye diseases</b>													
good	16	15.0 (9.4-22.9)	31	29.0 (21.2-38.2)	23	21.5 (14.8-30.2)	10	9.3 (5.2-16.4)	15	14.0 (8.7-21.9)	12	11.2 (6.5-18.6)	<0.001
moderate	41	8.7 (6.5-11.6)	123	26.1 (22.4-30.3)	124	26.3 (22.6-30.5)	64	13.6 (10.8-17.0)	93	19.7 (16.4-23.6)	26	5.5 (3.8-8.0)	
bad	23	4.6 (3.1-6.8)	97	19.5 (16.2-23.2)	113	22.7 (19.2-26.6)	76	15.3 (12.4-18.7)	151	30.3 (26.5-34.5)	38	7.6 (5.6-10.3)	

nurses can perform basic eye examinations (mostly visual acuity tests using the Snellen chart) [11, 24]. Patients with eye conditions or vision impairment are often referred to ophthalmologists and have comprehensive eye examinations [6]. Moreover, eye examinations are also offered by optic stores, e.g., when an individual with vision impairment visits an optic store to buy new spectacles or contact lenses. Optic stores are quite common in cities, including small cities below 20,000 inhabitants. A significant part of eye examinations is performed within private healthcare and paid out-of-pocket (e.g., when the patient needs spectacles or contact lenses) [25]. Moreover, law regulations also affect the frequency of eye examinations [16, 17]. Usually, employees are obligated to have medical check-ups (including eye examinations) every 2–4 years, as a part of occupational medicine [16]. Moreover, drivers are obliged to present eye test results when applying for a driving license. [17]. However, there is a lack of dedicated public health policy aimed at eye health and promoting regular eye examinations. Moreover, previously published data revealed a significant gap in the performance of preventive health screening during the COVID-19 pandemic in Poland [26].

The finding from this study showed that a significant percentage of Poles have not had regular eye examinations, even despite their high availability in primary care settings or optics stores. Only 54.9% of participants had eye examinations in the last two years, which is in line with

general recommendations for healthy adults [14]. More than 10% of adults aged 40 and under declared that they had never had eye examinations. Age is a significant risk factor for eye diseases [12], therefore young adults are less likely to experience eye symptoms or vision impairments that prompted them to use eye care services, such as eye examinations. Nevertheless, this finding requires further investigation.

Individuals with eye diseases or vision impairment are more likely to use eye healthcare services [27]. Moreover, individuals wearing spectacles or contact lenses often require regular check-ups and buy new spectacles for health or fashion reasons. Findings from the current study revealed that wearing spectacles or contact lenses was an important factor associated with the frequency of eye examinations. It can be hypothesized that those with vision impairments are more aware of eye diseases and disorders, and apply for eye examinations to detect eye diseases early or to ensure visual comfort and to adjust glasses to vision defects. This finding suggests that education on eye health is mostly provided by an ophthalmologist, as most patients with vision impairments require comprehensive eye care. Primary care physicians and nurses should be actively involved in eye health promotion and education [28].

Health literacy levels are positively related to health-promoting behaviours [29, 30]. A higher level of awareness of disease may encourage individuals to have screening tests.

**Table 3.** Factors associated with eye exams in the last 12 months or 2 years among adults in Poland (n=1092).

Variable	Eye exam in the last 12 months					Eye exam in the last 2 years				
	n (%)	Bivariable Logistic Regression		Multivariable Logistic Regression		n (%)	Bivariable Logistic Regression		Multivariable Logistic Regression	
		OR (95%CI)	p	aOR (95%CI)	p		OR (95%CI)	p	aOR (95%CI)	p
<b>Gender</b>										
male	147 (29.8)	1.00	0.5			258 (53.2)	1.00			
female	184 (31.6)	1.09 (0.84-1.41)				325 (55.0)	1.08 (0.85-1.37)	0.6		
<b>Age group (years)</b>										
18–29	62 (28.3)	1.00				109 (18.4)	1.00		1.00	
30–39	52 (24.6)	0.83 (0.54-1.27)	0.4			101 (17.1)	0.93 (0.64-1.35)	0.7	0.84 (0.56-1.27)	0.4
40–49	59 (31.7)	1.18 (0.77-1.80)	0.5			110 (18.6)	1.46 (0.98-2.17)	0.1	1.31 (0.83-2.06)	0.3
50–59	66 (33.2)	1.26 (0.83-1.91)	0.3			110 (18.6)	1.25 (0.85-1.83)	0.3	0.90 (0.57-1.41)	0.6
60+	92 (35.2)	1.38 (0.94-2.03)	0.1			161 (27.2)	1.63 (1.13-2.34)	0.01	1.14 (0.73-1.78)	0.6
<b>Educational level</b>										
higher education	147 (33.2)	1.21 (0.93-1.58)	0.1			264 (44.7)	1.38 (1.08-1.76)	0.01	1.19 (0.92-1.55)	0.2
less than higher	184 (29.1)	1.00				179 (36.9)	1.00		1.00	
<b>Currently married</b>										
yes	188 (33.5)	1.31 (1.01-1.70)	0.04	1.17 (0.85-1.61)	0.3	333 (56.3)				
no	143 (27.8)	1.00		1.00		228 (47.0)	1.00			
<b>Place of residence</b>										
rural area	130 (32.3)	1.01 (0.66-1.53)	0.9			224 (37.9)	1.14 (0.77-1.69)	0.5		
city < 20,000 inhabitants	31 (22.8)	0.63 (0.36-1.07)	0.1			63 (10.7)	0.79 (0.49-1.27)	0.3		
city ≥ 20,000 < 100,000 inhabitants	69 (32.5)	1.02 (0.64-1.62)	0.9			127 (21.5)	1.37 (0.88-2.11)	0.2		
city ≥ 100,000 < 500,000 inhabitants	58 (30.4)	0.92 (0.57-1.49)	0.7			107 (18.1)	1.17 (0.75-1.81)	0.5		
city ≥ 500,000 inhabitants	43 (32.1)	1.00				70 (11.8)	1.00			
<b>Having children</b>										
yes	227 (33.0)	1.35 (1.02-1.77)	0.04	1.10 (0.78-1.53)	0.6	398 (67.3)	1.39 (1.08-1.78)	0.01	1.17 (0.86-1.60)	0.3
no	104 (26.8)	1.00		1.00		290 (59.8)	1.00		1.00	
<b>Household size</b>										
living alone	41 (27.7)	0.87 (0.58-1.29)	0.5			79 (13.4)	0.99 (0.69-1.43)	0.9		
2 persons	119 (32.1)	1.07 (0.80-1.41)	0.7			214 (36.2)	1.19 (0.91-1.54)	0.2		
3 persons or more	171 (30.7)	1.00				298 (50.4)	1.00			
<b>Professional activity</b>										
active	199 (30.5)	0.97 (0.74-1.26)	0.8			372 (62.9)	1.23 (0.97-1.58)	0.1		
passive	132 (31.2)	1.00				219 (37.1)	1.00			
<b>Economic status</b>										
good	137 (33.1)	1.30 (0.92-1.83)	0.1			249 (42.1)	1.37 (1.01-1.88)	0.049	1.30 (0.93-1.81)	0.1
moderate	124 (30.4)	1.15 (0.81-1.62)	0.4			209 (35.4)	0.96 (0.70-1.31)		0.93 (0.67-1.30)	0.7
bad	70 (27.6)	1.00				133 (22.5)	1.00		1.00	
<b>Health status</b>										
healthy	167 (27.9)	1.00		1.00		200 (41.2)	1.00			
presence of at least one chronic condition	164 (34.3)	1.35 (1.04-1.75)	0.02	1.18 (0.90-1.55)	0.2	278 (47.0)	1.27 (0.99-1.61)	0.06		
<b>Wearing spectacles or contact lenses</b>										
yes	229 (38.6)	2.24 (1.78-3.07)	<0.001	2.17 (1.64-2.87)	<0.001	395 (66.8)	2.90 (2.26-3.72)	<0.001	2.71 (2.08-3.54)	<0.001
no	102 (21.2)	1.00		1.00		199 (41.0)	1.00		1.00	
<b>Self-reported knowledge of eye diseases</b>										
good	47 (43.9)	2.47 (1.60-3.81)	<0.001	2.35 (1.51-3.66)	<0.001	70 (11.8)	2.15 (1.39-3.33)	<0.001	1.96 (1.24-3.10)	0.004
moderate	164 (34.8)	1.68 (1.27-2.23)	<0.001	1.59 (1.20-2.12)	0.001	288 (48.7)	1.79 (1.39-2.31)	<0.001	1.67 (1.28-2.18)	<0.001
bad	120 (24.1)	1.00		1.00		233 (39.4)	1.00		1.00	

aOR – adjusted odds ratio (model adjusted to all variables statistically significant in bivariable analysis)

**Table 4.** Factors associated with eye exam in the last 3 years among adults in Poland (n=1092)

Variable	n (%)	Eye exam in the last 3 years			
		Bivariable Logistic Regression OR (95%CI)	p	Multivariable Logistic Regression aOR (95%CI)	p
<b>Gender</b>					
male	334 (67.7)	1.00	0.5		
female	407 (69.8)	1.10 (0.85-1.43)			
<b>Age group (years)</b>					
18–29	142 (64.8)	1.00		1.00	
30–39	123 (58.3)	0.76 (0.51-1.12)	0.2	0.53 (0.34-0.83)	0.01
40–49	135 (72.6)	1.44 (0.94-2.20)	0.1	0.99 (0.60-1.63)	0.9
50–59	149 (74.9)	1.62 (1.06-2.47)	0.03	0.86 (0.51-1.43)	0.6
60+	192 (73.6)	1.51 (1.02-2.23)	0.04	1.11 (0.67-1.85)	0.7
<b>Educational level</b>					
higher education	329 (74.3)	1.55 (1.18-2.03)	0.001	1.26 (0.94-1.69)	0.1
less than higher	412 (65.1)	1.00		1.00	
<b>Currently married</b>					
yes	414 (73.8)	1.62 (1.25-2.10)	<0.001	1.44 (1.04-2.01)	0.03
no	327 (63.5)	1.00		1.00	
<b>Place of residence</b>					
rural area	279 (69.2)	1.18 (0.78-1.78)	0.4		
city < 20,000 inhabitants	86 (63.2)	0.90 (0.55-1.48)	0.7		
city ≥ 20,000 < 100,000 inhabitants	153 (72.2)	1.36 (0.85-2.16)	0.2		
city ≥ 100,000 < 500,000 inhabitants	135 (70.7)	1.26 (0.79-2.02)	0.3		
city ≥ 500,000 inhabitants	88 (65.7)	1.00			
<b>Having children</b>					
yes	497 (72.2)	1.54 (1.18-2.00)	0.002	1.11 (0.77-1.61)	0.6
no	244 (62.9)	1.00		1.00	
<b>Household size</b>					
living alone	96 (64.9)	0.85 (0.58-1.25)	0.4		
2 persons	264 (71.2)	1.14 (0.86-1.52)	0.4		
3 persons or more	381 (68.4)	1.00			
<b>Professional activity</b>					
active	469 (71.8)	1.42 (1.09-1.84)	0.01	1.90 (1.36-2.65)	<0.001
passive	272 (64.3)	1.00		1.00	
<b>Economic status</b>					
good	296 (71.5)	1.38 (0.99-1.92)	0.06		
moderate	281 (68.9)	1.21 (0.87-1.69)	0.3		
bad	164 (64.6)	1.00			
<b>Health status</b>					
healthy	401 (67.1)	1.00			
presence of at least one chronic condition	340 (71.1)	1.21 (0.93-1.57)	0.2		
<b>Wearing spectacles or contact lenses</b>					
yes	481 (81.0)	3.64 (2.77-4.77)	<0.001	3.44 (2.57-4.60)	<0.001
no	260 (53.9)	1.00		1.00	
<b>Self-reported knowledge of eye diseases</b>					
good	80 (74.8)	1.81 (1.13-2.91)	0.01	1.65 (0.99-2.72)	0.05
moderate	352 (74.7)	1.81 (1.37-2.38)	<0.001	1.73 (1.29-2.33)	<0.001
bad	309 (62.0)	1.00		1.00	

Abbreviations: aOR – adjusted odds ratio (model adjusted to all variables statistically significant in bivariable analysis)

In this study, respondents who declared a good or moderate level of knowledge of eye diseases were more likely to have regular eye examinations. Almost half of the respondents declared a bad level of knowledge of eye diseases, indicating that further educational activities are needed.

Out of 12 different factors analyzed in this study, wearing spectacles or lenses and self-reported level of knowledge on eye diseases were the only factors significantly associated with higher odds of eye examinations in the last 12 months or two years.

As this study was carried out in December 2022, and the first COVID-19 case in Poland was reported at the beginning of March 2020 [31], the authors decided to run a separate analysis that would also cover pre-pandemic times (having eye examinations between December 2019 – December 2022). Out of 12 analyzed factors, five were significantly associated with eye examinations in the last three years. Except for the level of knowledge on eye diseases and wearing spectacles or lenses, being currently married and professionally active (currently employed/self-employed) were associated with higher odds of having an eye examination. Eye examinations are offered as a part of mandatory medical check-ups within occupational medical services [16, 17], allowing the hypothesis that this finding results from the law in force, rather than pro-healthy behaviours. Vision affects social behaviours, so it can also be hypothesized that married individuals were more likely to have eye examinations due to their social roles in families. Moreover, in the current study, respondents aged 30–39 years were associated with lower odds of having eye examinations. Most age-related eye diseases occur after 40 years of age, so it can be hypothesized that adults aged 30–39 years did not report eye symptoms. Moreover, contrary to young adults (18–29 years), a significant proportion of adults aged 30–39 years have completed their education and lead a stable lifestyle, which affects their health behaviours, including eye examinations.

Other studies showed that older age, being married and higher educational attainment are the factors associated with more frequent eye examinations [4, 32, 33]. In the current study, although the impact of marital status on the frequency of eye examinations was also confirmed, the impact of educational level on the frequency of eye examinations was not observed. Further studies in nationwide samples should be performed to identify the most effective strategies aimed at eye health promotion.

Findings from other European countries showed that rural populations may be at higher risk of eye diseases and may have limited access to eye care [34, 35]. In Hungary, the prevalence of diabetic retinopathy was significantly more common in rural than in urban areas [34]. Between 2018 – 2019 in Romania (Cluj County), three times fewer children were screened within paediatric vision screening in rural areas as compared to urban areas [35]. In the current study, place of residence was not significantly associated with the frequency of eye examinations.

This study has some practical implications:

1. data presented on the frequency of eye examinations study may be used by public health specialists and ophthalmologists for the assessment of the current eye health services in Poland.
2. The lack of socio-economic differences in the frequency of eye examinations suggests that there is a lack of significant health inequalities in access to preventive eye care.

3. The study showed that a significant proportion of adults in Poland have not had regular eye examinations, so public health interventions are needed to promote eye care and vision screening.

An educational campaign, including social media, should inform the public about the importance of eye examinations, as a prevention tool. General practitioners may also be actively involved in education on eye care and eye examinations, as they are the first line of contact with the patient. Moreover, the current study confirmed that a national strategy for eye care should be developed, and different healthcare workers (including nurses, optometrists/orthoptists) should actively participate in eye disease prevention programmes.

**Limitations of the study.** First, the frequency of eye examinations was self-reported and medical records were not verified as this was an anonymous cross-sectional survey. Second, respondents were asked about eye examinations in general, and questions on the type of eye tests were not addressed. Moreover, data on mandatory (law obligation e.g., as a part of occupational medicine) or voluntary screening was not addressed.

As this study was one of the first nationwide studies on the frequency of eye examinations among adults in Poland, further studies may focus on the comprehensiveness of the examination, as well as the healthcare worker who performed the test (including general practitioner, ophthalmologist, nurse, or optometrists). Further studies should also focus on paediatric vision screening in Poland. As a cross-sectional study design was used, recall bias should be mentioned as a limitation of this study.

## CONCLUSIONS

The study showed that a significant percentage of adults in Poland do not have regular eye examinations. There was a lack of socio-economic differences (including place of residence or economic status) in the frequency of eye examinations. Primary care physicians and nurses should promote routine eye examinations. There is an urgent need for health education on preventive eye examinations and eye care among adults in Poland.

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