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ORIGINAL RESEARCH

Comparative Analysis of Glaucoma Screening Uptake Among First-Degree Relatives After Community-Based and Hospital-Based Approaches

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Purpose: Glaucoma is the second leading cause of irreversible blindness globally. Primary open-angle glaucoma (POAG) can be genetically transmitted among first-degree relatives (FDRs). Therefore, screening for glaucoma in FDRs can significantly increase the chances of early detection. This study aimed to evaluate the differences in glaucoma screening uptake among FDRs in community and hospital-based settings and the underlying factors, as well as the prevalence of glaucoma in FDRs.

Patients and Methods: Probands and FDRs who underwent screening were classified into two: community-based (group 1) and hospital-based (group 2). They were invited for screening by Village Health Volunteers and ophthalmic nurses, respectively, using information brochures. The FDRs underwent eye examinations, and those with suspected glaucoma underwent further testing for confirmation.

Results: The response rates of probands were 261 (38.2%) for group 1 and 196 (48.8%) for group 2. The uptake screening of FDRs was 30.1% and 64.5%, respectively. Multivariate analysis identified that female FDRs {odds ratio [OR]=1.64; 95% CI 1.14–2.38} and those aged above 45 years (OR=2.06; 95% CI 1.32–3.21) were more likely to participate. FDRs residing outside Chanthaburi Province were less likely to attend than those within Chanthaburi (OR=0.36;95% CI 0.22–0.58). FDRs related to probands with blindness were more likely to participate (OR=1.69; 95% CI 1.13–2.54), as were FDRs with secondary school education or higher (OR=2.49;95% CI 1.48–4.18). Those receiving both medical and surgical treatment were more likely to participate (OR=2.22;95% CI 1.51–3.25). The prevalence of glaucoma was 8.3%, and 19.2% of screened FDRs were glaucoma suspects.

Conclusion: Group 1 showed a significantly lower screening uptake than Group 2. The factors influencing the uptake of screening by FDRs are gender, age, geographic location, visual acuity of the worse eye in probands, education status of FDRs, and treatment modalities of probands.

Keywords: glaucoma screening, first-degree relatives, community-based approach, hospital-based approach, familial risk factors

Introduction

Glaucoma is a major cause of vision loss globally, and it ranks second only to cataract. It leads to irreversible blindness. The World Health Organization (WHO)[1] reported 76 million patients with glaucoma globally in 2020, with an expected increase to 95.4 million by 2030. Studies, including one by Tham et al,[2] have shown that primary open-angle glaucoma (POAG) is more common in individuals older than 40 years; a prevalence of approximately 3.05% was reported in 2013.

Glaucoma is caused by increased intraocular pressure leading to optic nerve damage.[3,4] It is characterized by progressive irreversible neuropathy and reduced vision. While glaucoma can be treated to delay or prevent vision loss, most patients have no symptoms during the early stages. They often first visit a doctor when they start experiencing blurred vision or eye pain. However, significant vision loss and damage to the optic nerve may have already occurred, making it too late to preserve vision.

JM et al[5] studies on the cost-effectiveness of screening for POAG have found that screening can reduce the risk of disease progression and preserve vision. Without treatment, POAG carries the risk of blindness after approximately 23

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years, compared with 35 years for those who receive treatment. At the age of 40,[6] the prevalence of POAG is approximately 3–4%. Allison et al[6] reported that there are approximately 57.5 million people with POAG globally. The risk factors[2,6] of glaucoma include high intraocular pressure, older age, family history of glaucoma, African race, diabetes, and central corneal thickness less than 0.5 mm. A study in china[7] reported that POAG is usually diagnosed around the age of 43.3 years. Additionally, a positive family history of glaucoma increased its risk by 8.38 times relative to those with no family history of glaucoma. Siblings and/or offspring of patients with POAG[7,8] also have a high risk, and only being a sibling was associated with the severity of POAG.

In Thailand,[9–11] the shortage of medical professionals is considered a significant issue in the healthcare system. Consequently, access to information and communication about glaucoma among doctors, public health officials, and at-risk populations is still very limited. Glaucoma is often detected during its late stages,[9] when they have already suffered significant vision loss (irreversible blindness and/or visual field defect). Therefore, providing direct information and communication about glaucoma to patients and high-risk populations[12,13] (direct health education) is considered effective in preventing permanent vision loss, as it allows for early detection and treatment of the disease.

In Thailand's public health system,[14–17] village health volunteers play a crucial role in public health operations. In every sub-district, these village health volunteers, who are trusted members of the community, coordinate public health activities of the authorities and residents. Village health volunteers are primarily responsible for conducting proactive screening for various diseases,[14–17] such as diabetes, high blood pressure, COVID-19, and mental health. Therefore, providing knowledge to village health volunteers and having them pass on this knowledge to the patients and FDRs in the community will help improve the uptake of the screening program and facilitate early disease detection.

The main objective of this study is to evaluate the differences in glaucoma screening uptake among FDRs in community-based and hospital-based settings. Additionally, this study investigated the determinants of participation in glaucoma screening programs and the prevalence of glaucoma in FDRs.

Materials and Methods

This prospective comparative study protocol was approved by the Prapokklao Hospital Ethics Committee (CTIREC 022/65). The study adhered to the tenets of the Declaration of Helsinki, and all participants provided written informed consent. The Institutional Review Board approved the present study.

All patients with POAG who were treated in the ophthalmology outpatient department of Prapokklao Hospital, Chanthaburi Province, were identified from the Electronic Medical Record (EMR) database using the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) code "Primary open-angle glaucoma H40.1". A total of 1304 patients were included in this study. Those with primary closed-angle and secondary glaucoma due to other conditions such as trauma, post-surgical complications, uveitis, or congenital glaucoma. These probands were divided into two non-randomized groups. The hospital-based group, included all probands receiving treatment in the ophthalmology outpatient department of Prapokklao Hospital from December 1, 2022, to February 2, 2023. After undergoing scheduled check-ups, these patients received information about glaucoma from the ophthalmic nurses, along with a brochure detailing the causes, symptoms, risk factors, diagnosis, and treatments. The brochure highlighted the familial association of glaucoma, emphasizing the need for early detection to prevent visual impairment and irreversible blindness. Subsequently, these patients were asked to invite their FDRs—parents, siblings, and offspring aged 40 years and above—to participate in glaucoma screening. If the FDRs did not attend the screening within one month after invitation, nurses would directly contact (renotify) them to inquire about the reasons for non-participation and, if interested, schedule a screening appointment.

For the community-based group, convenience sampling technique was utilized to randomly select districts in Chanthaburi Province, including Muang and Laem Sing districts. After excluding the patients already in the hospital-based group from the EMR database, 682 probands remained in the community group. In this group, general nurses and village health volunteers trained in glaucoma knowledge by an ophthalmologist similar to the hospital-based group. The general nurse called the patients to provide information about the disease and invited them to participate in the screening program. After that, the village health volunteers distributed brochures to the homes of the patients to encourage and educate them and their FDRs on the need to participate in the screening. These FDRs were invited to participate in the

glaucoma screening program one month later, with ophthalmologists conducting screening at the community hospital near homes in Muang and Laem Sing district between March 1, 2023, and May 31, 2023. If the FDRs did not attend the scheduled screening, the nurse would renotify them to ensure participation and inquire about the reasons for non-participation and, if interested, schedule a screening appointment at Prapokklao Hospital.

Detailed information was collected from all the patients with glaucoma and their FDRs participating in this study such as age, underlying disease, address, time of glaucoma diagnosis, history of treatment of glaucoma, and relationship with the glaucoma patient. For the FDRs participating in the screening, the eye examinations included visual acuity assessment using the Snellen chart, ocular tension by air-puff tonometry, color fundus performed by trained paramedical personnel, anterior segment examination using a slit lamp, and gonioscopy performed by a glaucoma specialist.

If FDRs had enlarged cupping greater than 0.7 or asymmetry in vertical cup-to-disc ratio (VCDR) greater than 0.2 and/or ocular tension ≥ 21 mmHg, an appointment was scheduled within 2–4 weeks at Prapokklao Hospital. This was for the repeated determination of ocular tension using Goldmann applanation tonometry (GAT), visual field testing program 24–2 (using Humphrey Field Analyzer; HFA, Carl Zeiss Meditec, Dublin, CA), optic nerve head examination (OCT-ONH), and retina nerve fiber layer (RNFL) analysis (using Stratus Optical Coherence Tomography; stratus OCT, Carl Zeiss Meditec, Dublin, CA) to confirm the diagnosis. The diagnosis was "normal finding" (no glaucoma), "glaucoma suspect", or "glaucoma patient" using predetermined study definitions. The diagnosis of glaucoma was based on the classification system of the International Society of Geographical and Epidemiological Ophthalmology (ISGEO) 4 as follows. A glaucoma suspect was characterized as an individual with any of the following: IOP of ≥ 21 mmHg, vertical cup disc ratio (VCDR) of ≥ 0.7, or VCDR asymmetry of > 0.2. Primary open-angle glaucoma (POAG) was defined as IOP of ≥ 21 mmHg, open anterior chamber on gonioscopy, glaucomatous changes in the optic disc such as increased VCDR, and visual field defects characteristic of glaucoma (nasal step, arcuate field defect or paracentral depression in clusters of test sites).

Statistical Analysis

Sample Size Determination

The sample size was calculated using Stata 12.1 software. This calculation was based on a study by Ogunleye et al[18] FDRs who participated in glaucoma screening accounted for 30.1% of those in the control group and 48.9% of those in the intervention group. Using a 95% confidence interval (z=1.96) with a precision level set at 10% (power= 0.9), the calculated sample size for each group was 151 people, yielding a total of 302 people.

Data Analysis

For data analysis, a ready-made software program was used. General data were analyzed using descriptive statistics, including percentages, mean values, and standard deviation. For the comparison of the categorical data of the groups, the Chi-squared or Fisher's exact test was used. The independent *t*-test and Mann–Whitney *U*-test were used to analyze continuous data. Both univariable and multivariable logistic regressions were used as tests of association. P-values less than 0.05 denoted statistical significance. Figure 1 shows an overview of the glaucoma study workflow involving electronic medical records (EMR) and the categorization of individuals into various groups and subgroups.

Results

According to Table 1, a total of 457 patients with probands participated in this study. The participants were divided into two: 261 in the community-based group and 196 in the hospital-based group. The average age of the patients in the study was 70.0 ± 8.1 years. Their ages ranged from 41 to 96 years, and most were older than 65 years.

Of the probands in the community-based group, 112 patients (42.9%) had normal/mild visual impairment (VI). In the hospital-based group, 73 patients (37.2%) had moderate VI. In the community-based group, 177 individuals (76.8%) lived in the urban area of Chanthaburi. In the hospital-based group, 106 individuals (54.1%) lived outside the urban area of Chanthaburi.

The majority of probands received treatment with anti-glaucoma medication and surgery (cataract surgery and/or trabeculectomy) in the community-based group (171 patients; 65.5%) and the hospital-based group (124 patients;

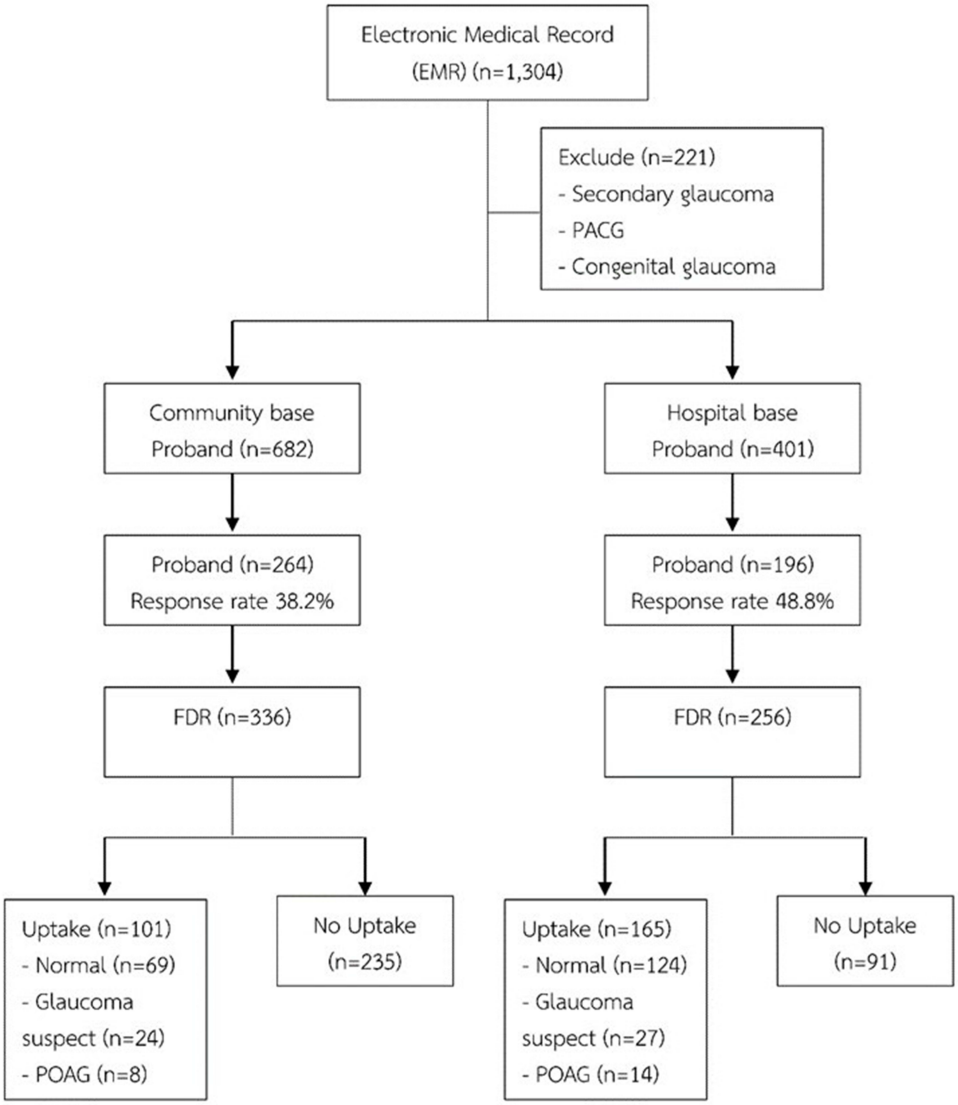

Figure 1 Flow diagram for study participants.

63.3%). The duration of treatment for probands was predominantly less than 5 years for 173 patients (66.3%) in the community-based group and 97 patients (49.5%) in the hospital-based group.

In the community-based group, 152 patients (58.2%) had an education level lower than primary education. However, in the hospital-based group, 101 patients (51.5%) had secondary education.

A total of 592 FDRs participated in this study, of which 242 (40.9%) were male and 350 (59.1%) were female. The average ages of the two groups of FDRs were similar, as shown in Table 2. Most FDRs in both groups were offspring, with 222 individuals (66.1%) in the community-based group and 193 individuals (75.4%) in the hospital-based group.

Regarding the visual acuity of probands in the worse eye, most FDRs in the community-based group had normal/mild VI, totaling 137 individuals (40.7%). In the hospital-based group, most had moderate VI, totaling 92 individuals (35.9%). From history taking about the refraction of FDRs, it was observed that most participants in both groups had vision within normal limits. In terms of the education level of FDRs, both groups had tertiary education or higher, totaling 230 individuals (38.9%).

Regarding the residence of FDRs in the community-based group, the proportions of FDRs who lived in the urban area of Chanthaburi and rural districts were equal, with 128 (38.1%) individuals in each group. Most participants in the

Table 1 Sociodemographic Characteristics of All Probands

Sociodemographic Characteristics	Group (N, %)		Total	P-value
	Community-Based	Hospital-Based		
Sex:				
Male	119 (45.6)	98 (50.0)	217 (47.5)	0.351
Female	142 (54.4)	98 (50.0)	240 (52.2)	
Mean age of probands	69.9±7.9	70.2±8.5	70.0±8.1	0.637
Age (years):				
<45	1 (0.4)	2 (1.0)	3 (0.7)	0.50
45–65	72 (27.6)	47 (24.0)	119 (26.0)	
>65	188 (72.0)	147 (75.0)	335 (73.3)	
Visual acuity: better eye				
Normal/mild VI*	230 (88.1)	151 (77.0)	381 (83.4)	0.017
Moderate VI	24 (9.2)	34 (17.3)	58 (12.6)	
Severe VI	4 (1.5)	5 (2.6)	9 (2.0)	
Blind	3 (1.2)	6 (3.1)	9 (2.0)	
Visual acuity: worse eye				
Normal/mild VI	112 (42.9)	57 (29.1)	169 (37.0)	0.001
Moderate VI	70 (26.8)	73 (37.2)	143 (31.2)	
Severe VI	19 (7.3)	5 (2.6)	24 (5.3)	
Blind	60 (23.0)	61 (31.1)	121 (26.5)	
Treatment:				
Medical	90 (34.5)	72 (36.7)	162 (35.5)	0.618
Both medical + surgery/laser	171 (65.5)	124 (63.3)	295 (64.5)	
Duration of diagnosis (years):				
≤5	173 (66.3)	97 (49.5)	270 (59.1)	0.001
6–10	75 (28.7)	82 (41.8)	157 (34.4)	
>10	13 (5.0)	17 (8.7)	30 (6.5)	
Place of residence:				
Within Chanthaburi	177 (76.8)	90 (45.9)	267 (58.4)	<0.001
Outside Chanthaburi	84 (32.2)	106 (54.1)	190 (41.6)	
Educational status of probands:				
Nil	57 (21.8)	10 (5.1)	67 (14.7)	<0.001
Primary	95 (36.4)	55 (28.1)	150 (32.8)	
Secondary	76 (29.2)	101 (51.5)	177 (38.7)	
Tertiary	33 (12.6)	30 (15.3)	63 (13.8)	

Notes: VI* visual impairment (WHO classification visual impairment 2018: Normal/mild VI ≥ 20/70, Moderate VI 20/70–20/200, Severe VI 20/200–20/400, Blind < 20/400, No light perception).

hospital-based group resided in rural districts (143 individuals; 55.9%). Most FDRs in both groups did not have any underlying diseases.

Of the FDRs who underwent glaucoma screening in the hospital-based group, 165 individuals (64.5%) participated; this is higher than the 101 individuals (30.06%) in the community-based group. There was a statistically significant difference (odds ratio = 4.21; 2.98–5.96) (P<0.001), as shown in Table 3.

For 457 probands who participated in this study, 592 FDRs were invited, with 266 undergoing examinations (44.9%). Of these, 90 were male (37.2%), and 176 were female (50.3%). Out of the 266 FDRs examined, 22 individuals (8.3%) had glaucoma. Of 101 individuals in the community-based group, 8 (7.9%) had glaucoma, 24 (23.8%) were suspected of glaucoma, and 69 (68.3%) had normal eyes. Of 165 individuals in the hospital-based group, 14 (8.5%) had glaucoma, 27 (16.4%) were suspected of glaucoma, and 124 (75.2%) had normal eyes, as shown in Table 4.

Females were more likely to present for examination than males (odds ratio = 1.70; 1.22–2.38) (P=0.002), as were FDRs in older age group (age > 45 years) (odds ratio=1.48; 1.04–2.10) (P=0.027). The FDRs residing outside the

Table 2 Sociodemographic Characteristics of All Enrolled First-Degree Relatives

Sociodemographic Characteristics	Group (N, %)		Total	P-value
	Community-Based	Hospital-Based		
Sex:				
Male	144 (42.9)	98 (38.3)	242 (40.9)	0.262
Female	192 (57.1)	158 (61.7)	350 (59.1)	
Mean age of FDRs	51.5±11.1 (50.3–52.7)	50.1 ±9.2 (49.0–51.3)	50.9 ±10.4 (50.1–51.8)	0.107
Age (years):				
<45	133 (39.6)	89 (34.8)	222 (37.5)	0.011
45–65	161 (47.9)	150 (58.6)	311 (52.5)	
>65	42 (12.5)	17 (6.6)	59 (10.0)	
Relationship with probands:				
Parents	6 (1.8)	0 (0.0)	6 (1.0)	0.010
Siblings	108 (32.1)	63 (24.6)	171 (28.9)	
Offspring	222 (66.1)	193 (75.4)	415 (70.1)	
Presenting VA of the worse eye with probands:				
Normal/mild VI*	137 (40.7)	47 (18.4)	184 (31.1)	0.001
Moderate VI	103 (30.7)	92 (35.9)	195 (32.9)	
Severe VI	14 (4.2)	47 (18.4)	61 (10.3)	
Blind	82 (24.4)	70 (27.3)	152 (25.7)	
Refraction:				
Normal	217 (64.6)	184 (71.9)	401 (67.7)	0.06
Abnormal	119 (35.4)	72 (28.1)	191 (32.3)	
Educational status of FDRs:				
Nil	40 (11.9)	9 (3.5)	49 (8.2)	0.001
Primary	94 (28.0)	63 (24.6)	157 (26.5)	
Secondary	82 (24.4)	74 (28.9)	156 (26.4)	
Tertiary	120 (35.7)	110 (43.0)	230 (38.9)	
Place of residence:				
Muang Chanthaburi	128 (38.1)	73 (28.5)	201 (33.9)	<0.001
Other district Chanthaburi	128 (38.1)	143 (55.9)	271 (45.8)	
Other Province	80 (23.8)	40 (15.6)	120 (20.3)	
Underlying disease				
No	251 (74.7)	195 (76.2)	446 (75.3)	0.681
Yes	85 (25.3)	61 (23.8)	146 (24.7)	

Table 3 Association Between Uptake of Screening by First-Degree Relatives

Study Group	Uptake of Screening of FDRs		Total	OR (95% CI)	P-value
	Yes	No			
Community-based	101 (30.06)	235 (69.94)	336 (100)	1	<0.001
Hospital-based	165 (64.5)	91 (35.5)	256 (100)	4.21 (2.98–5.96)	
Total	266 (44.93)	326 (55.07)	592 (100)		

province of Chanthaburi were less likely to participate than those living within Chanthaburi (odds ratio = 0.33;0.21–0.52) (P < 0.001). Siblings and offspring reported for examination just like the parents. FDRs with education status above secondary school were more likely to present for examination than those with primary school education (odds ratio= 1.46; 1.03–2.06) (P = 0.03).

Table 4 Prevalence of Glaucoma Among First-Degree Relatives

Diagnosis (Uptake)	Group (N, %)		Total	P-value
	Community-Based	Hospital-Based		
Normal	69 (68.3)	124 (75.1)	193 (72.6)	0.330
Glaucoma suspect	24 (23.8)	27 (16.4)	51 (19.2)	
Glaucoma	8 (7.9)	14 (8.5)	22 (8.2)	
	101	165	266	

The associations between the uptake of screening by FDRs and the characteristics of FDRs or probands are depicted in Tables 5 and 6. Probands with blindness in the worse eye tended to present for examination than those with normal or mild visual loss (odds ratio = 1.86; 1.27–2.72) (P = 0.001). The FDRs of probands who had been diagnosed for more than 5 years were more likely to uptake screening (odds ratio = 1.45; 1.05–2.02) (P = 0.023). Probands with both medical and surgical treatment were more likely to present for examination than those who received only medical treatment (odds ratio = 2.22; 1.57–3.12) (P < 0.001).

Multivariate analysis with adjustment for all variables, the statistical significance of tested association is sex, age of FDRs, place of residence of FDRs, education of FDRs, presenting visual acuity in worse eye of probands, and treatment of probands shown in Table 6 (P < 0.05).

Table 5 Factors Affecting Glaucoma Screening Uptake of First-Degree Relatives

Risk Factor	Screening Uptake		Total	P-value
	No (n, %)	Yes (n, %)		
Age of FDRs				
<45 y	135 (60.8)	87 (39.2)	222 (100)	0.085
45–65 y	159 (51.1)	152 (48.9)	311 (100)	
>65 y	32 (54.2)	27 (45.8)	59 (100)	
Gender				
Female	174 (49.7)	176 (50.3)	350 (100)	0.002
Male	152 (62.8)	90 (37.2)	242 (100)	
Relationship with probands				
Parents	4 (66.7)	2 (33.3)	6 (100)	0.289
Siblings	102 (59.7)	69 (40.3)	171 (100)	
Offspring	220 (53.0)	195 (47.0)	415 (100)	
Place of residence of FDRs				
Inside	236 (50.0)	236 (50.0)	472 (100)	<0.001
Outside	90 (75.0)	30 (25.0)	120 (100)	
Education of FDRs				
Nil/Primary	126 (61.2)	80 (38.8)	206 (100)	0.029
Secondary/Tertiary	200 (51.8)	186 (48.2)	386 (100)	
Presenting VA of worse eye with probands				
Normal/Mild VI	213 (56.2)	166 (43.8)	379 (100)	<0.001
Moderate/Severe VI	51 (83.6)	10 (16.4)	61 (100)	
Blind	62 (40.8)	90 (59.2)	152 (100)	
Duration of diagnosis of probands				
≤5 y	179 (59.7)	121 (40.3)	300 (100)	0.023
>5 y	147 (50.3)	145 (49.7)	292 (100)	
Treatment of probands				
Medical	235 (62.2)	143 (37.8)	378 (100)	<0.001
Medical + Surgery	91 (42.5)	123 (57.5)	214 (100)	

Table 6 Univariable and Multivariable Logistic Regression Analysis Showing Predictors of First-Degree Relative Screening Uptake

Risk factor	Univariable Regression Analysis			Multivariable Regression Analysis		
	OR	95% CI	P-value	OR	95% CI	P-value
Age of FDRs (y)						
<45	1	Ref.		1	Ref.	
45–65	1.48	1.04–2.10	0.027	2.06	1.32–3.21	0.001
>65	1.309	0.73–2.33	0.361	2.52	1.14–5.56	0.021
Gender of FDRs						
Female	1.70	1.22–2.38	0.002	1.64	1.14–2.38	0.008
Male	1	Ref.	0.002	1	Ref.	
Relationship of FDRs with probands						
Parents	1	Ref.		1	Ref.	
Siblings	1.35	0.24–7.59	0.73	1.53	0.26–9.11	0.635
Offspring	1.77	0.32–9.78	0.51	1.76	0.30–10.41	0.528
Place of residence of FDRs						
Within Chanthaburi	1	Ref.		1	Ref.	
Outside Chanthaburi	0.33	0.21–0.52	<0.001	0.36	0.22–0.58	<0.001
Educational status of FDRs						
>Secondary/Tertiary	1.46	1.03–2.06	0.03	2.49	1.48–4.18	0.001
Nil/Primary	1	Ref.		1	Ref.	
Presenting VA in the worse eye (probands)						
Blind	1.86	1.27–2.72	0.001	1.69	1.13–2.54	0.011
Moderate/Severe VI	0.25	0.12–0.51	<0.001	0.21	0.10–0.44	<0.001
Normal/mild VI	1	Ref.		1	Ref.	
Duration of diagnosis in probands						
≤5 yrs	1	Ref.		1	Ref.	
>5 yrs	1.45	1.05–2.02	0.023	1.19	0.83–1.71	0.35
Treatment of probands						
Medical	1	Ref.		1	Ref.	
Both Medical and Surgical	2.22	1.57–3.12	<0.001	2.22	1.51–3.25	<0.001

Abbreviations: POAG, primary open-angle glaucoma; FDRs, first-degree relatives; VI, visual impairment.

The reasons of FDRs for not presenting for screening include lack of awareness, being busy, and distance to the screening location. These reasons account for 86.4% of the community-based group and 80.2% of the hospital-based group. A later reason was that they had accessed examinations at other clinics/hospitals; this accounted for 13.6% in the community-based group and 19.8% of the participants in the hospital-based group.

Discussion

This study found that FDRs in the hospital-based group patronized glaucoma screening at a rate of 64.5%, which was higher than the 30.06% for the community-based group (odds ratio = 4.21; 2.98–5.96) (P<0.001). Previously, no research had compared these two groups. This study demonstrates that FDRs in the hospital-based group were more aware and recognized the importance of glaucoma screening than those in the community-based group. An important factor may be the difference in information received. For the hospital-based group, information was provided by the ophthalmic nurses, which may be more credible than information provided by the general nurses and village health volunteers in the community-based group.

The study also found a total screening response rate of 44.9% for the FDRs, which was similar to that reported by Salihu et al[19] (48%) and Ogunleye[18] (38.9%). This contrasts with the report by Rajendrababu[20] of a 7% response rate. The variation in response rates may be attributed to different methods of inviting FDRs to participate. This study and that by Ogunleye[18] used direct communication from nurses and/or village health volunteers and through brochures. The study

by Rajendrababu[20] relied only on mail and brochures. Direct communication seems to increase understanding and provide immediate clarification of doubts, thus improving response rates.

The factors influencing the uptake of glaucoma screening include age, with most FDRs being older than 45 years. The average age of FDRs in this study was 50.9 years, which was similar to that reported by Rajendrababu[20] (average age 56.8 years) but different from that reported by Ogunleye,[18] where most FDRs were younger than 50 years old with an average age of 42.5 years. The difference may be attributed to the age criteria for including FDRs in the studies. This study included FDRs aged 40 years and above, unlike those by Ogunleye[18] and Nagar,[21] which included FDRs aged 30 years and above.

The relationship with probands also played a role; most FDRs in this study were offspring, as in the study by Ogunleye[18] and Rewri et al[22] This may be because younger offspring are more aware of the disease, have a longer life expectancy, and are more mobile than other groups. However, this differs from the report by Rajendrababu[20] that most FDRs were siblings.

This study found that FDRs with education higher than secondary are more likely to undergo more significant screening, similar to the study by Rewri et al[22] and Sarimiye TF et al[12] This may be because higher education leads to greater knowledge and understanding of diseases, resulting in increased awareness and occurrence of diseases.

The presenting visual acuity (VA) of probands significantly influenced the uptake of screening of FDRs ($P<0.001$), especially for probands with VA worse than moderate VI. This may be attributed to the close relationship between probands and FDRs, as a decrease in the vision of probands markedly affects daily life. This study also found that secondary, tertiary, or higher levels of education of FDRs significantly affected screening uptake ($P=0.001$), indicating that education level increases awareness of the severity and prevention of the disease.

The place of residence also influenced screening participation. FDRs living in urban areas in Chanthaburi were more likely to participate than those in rural areas, similar to the report by Shroff et al[23] that distance was a factor in deciding to undergo screening. Proximity to screening locations increased participation.

The history of treatment of the probands, including both medical and surgical, significantly influenced the participation of FDRs in screening ($P<0.001$), unlike in previous studies.[18] However, the duration of diagnosis of probands did not show a significant difference in the multivariate regression analysis, possibly due to the diversity of treatment methods and the prognosis of glaucoma.

In Thailand, Metheetrairut et al[24] found a glaucoma prevalence of 6.1% for the general population older than 60 years; POAG and primary closed angle glaucoma accounted for 47.7% and 41.4%, respectively. Another study by Asanathong[25] involving individuals aged 18 years and above reported a prevalence of 7.4%; POAG, primary closed angle glaucoma, and glaucoma suspects accounted for 2.1%, 5.3%, and 26.3%, respectively. The Baltimore Eye Survey[7,8,26] found that a positive family history increased the risk of POAG, with the highest risk in siblings (odds ratio = 3.69), followed by those in parents (odds ratio = 2.17) and children (odds ratio = 1.12). A study in China[7,8] found that a positive family history increased the risk of POAG by 8.38 times relative to a negative family history, especially for siblings and offspring. In India,[20] a study of FDRs of patients with POAG found a 13.3% glaucoma prevalence, with 60% being siblings. Similarly, the study by Salihu[19] found 10.4% of FDRs diagnosed with POAG and 6.2% suspected of glaucoma after screening. This study also found a glaucoma prevalence of 8.3% and a glaucoma suspicion rate of 19.2% among screened FDRs.

Future Direction and Limitations

The benefits observed in this study demonstrate that health education interventions by village health volunteers effectively encourage high-risk individuals to patronize screening programs, leading to a detection rate of up to 7.9% of cases for all community-based screenings. This highlights the significant benefits of such interventions. The recommendations from this study can be applied to other eye diseases. Training village health volunteers at the district and sub-district levels for eye diseases is beneficial, as it can increase proactive screening efforts and lead to the early detection of disease among the at-risk population. Additionally, implementing a national free screening glaucoma program for at-risk populations in and outside hospitals and organizing mobile screening units at the district level may be an effective prevention strategy against permanent vision loss from glaucoma.

A limitation of this study is that it did not employ randomization for the grouping, resulting in the general information of the two groups not being similar from the beginning. Furthermore, the dissemination of knowledge and the

significance of the disease are not comprehensive for all individuals in the area, potentially leading to incomplete and insufficient communication to the public. Additionally, the area in Chanthaburi province where the data were collected is predominantly agricultural, and most of the residents are farmers. The data collection period, particularly from January to April, coincided with the harvesting season for agricultural products, which may have affected the participation of both probands and FDRs who may not be available to join the study.

Conclusion

The study shows that the hospital-based group had a significantly higher screening uptake than the community-based group, reflecting that information from the ophthalmic nurses is more effective and well-received than that from general nurses and village health volunteers. For FDRs, the significant factors influencing the patronage of screening programs include gender, age, geographic location, visual acuity of the worse eye in probands, education status of FDRs, and treatment modalities of probands.

Disclosure

The authors report no conflicts of interest in this work.

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