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The Prevalence of Visual Impairment of the Elderly at University Eye Clinic

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Abstract

The purpose of this study is to determine the prevalence and causes of visual impairment of the elderly who came to Rangsit University Eye Clinic for eye services in 2020-2021. Medical charts of elderly patients aged 60 years and older were retrospectively reviewed. Demographic data collected included age, gender, and underlying diseases. Data on refraction by optometrists and eye examination by ophthalmologists were collected. The Visual impairment was categorized using WHO definitions. The study included 1,452 patients aged 60 years and older with a mean age of 69.6 ± 8.09 years (range 60 to 110 years). Visual impairment was classified using presenting visual acuity (PVA) and best corrected visual acuity (BCVA). The prevalence of bilateral blindness and bilateral moderate and severe visual impairment (MSVI) using PVA were 6.20% and 69.56% respectively. When using BCVA, bilateral blindness, and bilateral MSVI were 0.69% and 11.02% respectively. Bilateral blindness did not increase with aging (p =0.125) and no gender difference (p=0.521) when using PVA. If using BCVA, bilateral MSVI did not increase with aging (p=0.920) and no gender difference (p=0.242) For eye diseases causing MSVI, were cataract, glaucoma, retinal detachment, epiretinal membrane, diabetic retinopathy and age-related macular degeneration, branch retinal vein occlusion. The emerging cause of bilateral blindness and bilateral MSVI were myopic macular degeneration. In conclusion, this study investigated the prevalence of visual impairment in the elderly population at the University Eye Clinic. Since visual impairment from these diseases can be prevented or treated, planning for eye health promotion and prevention, with the involvement of appropriate eye personnel for screening, is therefore necessary to prevent avoidable visual impairment.

Keywords**:** *Visual impairment; eye diseases; elderly; myopic macular degeneration; university eye clinic.*

1. Introduction

Numerous studies from around the world have documented the high incidence of visual impairment and blindness. The World Health Organization (WHO) classifies moderate and severe vision impairment (MSVI), which was formerly known as low vision, as having a visual acuity ranging from less than 6/18 to 3/60, while blindness is defined as a visual acuity of less than 3/60 or a visual field of less than 10° around central fixation (World Health Organization, 2023). In 2020, the main causes of blindness in individuals aged 50 and above were identified as cataracts, glaucoma, uncorrected refractive error (URE), age-related macular degeneration (AMD), and diabetic retinopathy (DR) (Bourne et al., 2020). The principal contributors to MSVI were URE and cataracts (Flaxman et al., 1997). Several national surveys in Thailand investigating the reasons behind visual impairment and blindness have indicated cataracts as the top cause, followed by URE, glaucoma, and corneal disorders.

Nearly 23% of world's population (1,406 million) has myopia (SE≤0.50 D) and 3% (163 million)

have high myopia (≤ -5.00 D). Individuals with high myopia are at increased risk of myopic macular degeneration (MMD), posterior staphyloma, chorioretinal atrophy, and macular atrophy (Wong et al., 2018). MMD has been reported as cause of visual impairment in Thai children (Wongkittirux, 2012) but has not yet been reported in Thai adults or Thai elderly.

Since most blindness and vision impairment is either preventable or treatable, there is a significant need for comprehensive eye health services to mitigate avoidable visual impairment. Given the expanding elderly population, there has been a significant increase in the incidence of age-related eye conditions and visual impairment (GBD 2019 Blindness Causes Collaborators, 2021). The most effective approach to prevent blindness involves early detection and treatment of these preventable causes. Hence, it is crucial to pinpoint the causes of visual impairment in the elderly.

Among the past reports that have explored the prevalence and causes of blindness and visual impairment only a handful have focused specifically on the elderly population. The goal of our study is to investigate visual impairment and age-related eye diseases among the elderly attending a university eye clinic and to assess the relationship between age and gender on visual impairment.

2. Objectives

To determine the prevalence and causes of visual impairment of the elderly who presented for eye services in 2020-2021 at Rangsit University Eye Clinic.

3. Patients and Methods

The study was carried out in compliance with the Helsinki Declaration's guidelines and received approval from the Human Research Ethics Committee at Rangsit University (RSU-ERB2022 160 0709). While the committee excused the requirement for informed consent, the case report forms were designed to not be linked to patient identities, ensuring confidentiality. The study involved a retrospective review of medical records from patients who visited the eye clinic at Rangsit University (RSU Healthcare) between January 2020 and December 2021. Inclusion criteria included those who were 60 years and older and those who had complete examination and follow up. All patients had complete vision tests and ophthalmic examinations. The demographic data included age, gender, and underlying diseases. The clinical data included presenting vision acuity (PVA), best-corrected visual acuity (BCVA), intraocular pressure (IOP), refraction, and eye diseases.

All examinations were carried out in the following order. First, presenting vision acuity (PVA) was tested using the Snellen chart at 6 meters. If the PVA was less than 20/20 and improved with pinhole, then both objective auto-refraction (Topcon KR 800. Topcon Inc, Japan) and subjective manifest refraction were done to determine the BCVA. The refractive sphere and cylinder power were converted into spherical equivalent (SE). The average SE of both eyes was recorded and used for analysis.

The anterior segment examination was done with slit lamp biomicroscopy. Measurement of the IOP was initially screened using a non-contact tonometer (Canon TX-20, Canon, Japan). All patients with an IOP more than 22 mmHg were then re-measured with a Goldmann applanation tonometer (GAT). Non-mydriatic fundus photographs were recorded using Topcon TRC-NW 6S (Topcon Inc, Japan) or KOWA Vx 10i (KOWA Inc, Japan). The pupils were dilated with Tropicamide 1% eye drop in the case of lens opacity or requiring fundus details such as those who had history of diabetes mellitus or glaucoma. The diagnosis of eye diseases was confirmed by an experienced ophthalmologist.

A specialist in retinal diseases diagnosed posterior segment eye diseases. AMD was diagnosed based on the standards set by the International Age-Related Maculopathy Epidemiological Study Group (Bird et al., 1995). In diabetic patients, the presence of DR was determined through the examination of fundus photographs, using criteria established by the Early Treatment Diabetic Retinopathy Study Research Group (Solomon, & Goldberg, 2019), along with Thai protocols (Supapluksakul et al., 2008; Silpa-archa, & Ruamviboonsuk, 2017). Glaucoma was identified when intraocular pressure (IOP) exceeded 22 mmHg, along with glaucomatous changes in the optic nerve head (Jenchitr, & Jaradaroonchay, 2021). These changes included a cup-to-disc ratio (C/D) of 0.6 or higher, C/D asymmetry of more than 0.2, rim notching or splinter hemorrhages, and abnormal glaucomatous visual field defects (Foster et al., 2002; Gedde et al.,

2021). MMD is diagnosed based on retinal atrophy, lacquer cracks, choroidal ischemia, choroidal neovascularization, and retinal detachment (Wong et al., 2018).

4. Statistical analysis

The data were presented as means and standard deviations for continuous variables and percentages for categorical variables. The associations of each eye disease with age and gender were explored using univariate regression analysis, and further explored in multivariable logistic regression models. Statistical analysis was calculated using the SPSS program version 29 and a *p*-value less than 0.05 was considered significant.

5. Results

Of the 22,563 patients who attended eye clinic, examination records for the 1,898 patients (8.4%) who were 60 years and older were included in this study. Of these, 446 records were excluded due to incomplete data and hence a total of 1,452 patient records (Table 1) were used in the analysis. Their mean age was 69.6 ± 8.09 (range 60-101) years, and 54.27% were female. The most common underlying systemic health conditions were systemic hypertension (377 patients, 25.96%), dyslipidemia (253 patients, 17.42%), diabetes mellitus (222 patients, 15.29%) and cardiovascular diseases (67 patients, 4.61%). The prevalence of eye diseases is shown in Table 2. The patients were divided into 3 age groups: 60-69 years, 70-79 years and 80 years and above for analysis of the association with age.

Of 1,452 patients in our study, 185 patients had error in measurement of refraction due to cataract and other media opacities while 1,033 (71.14%) had refractive error. The remaining had cataract, glaucoma, dry eye, retinal breaks, holes and macular hole, epiretinal membrane, diabetic retinopathy, age-related macular degeneration and myopic macular degeneration (Table 2). Visual impairment by age group using the better eye of presenting visual acuity (PVA) and best corrected visual acuity (BCVA) with their causes are shown in Tables 3 and 4.

Table 1 Elderly patients with eye examination between January 1, 2020 to December 31, 2021

Age range (years)	Number of attending elderly patients			Number of elderly with refraction			Number of elderly with eye examination with follow up		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
60-69	554	607	1,161	356	380	736	422	465	887
70-79	217	296	513	148	219	367	166	230	396
≥80	114	110	224	49	115	164	63	106	169
Total	885	1,013	1,898	553	714	1,267	651	801	1,452

Table 2 Eye diseases in the elderly patients by age groups

Eye diseases causing visual impairment	60-69 years (887) n (%)	70-79 years (396) n (%)	≥ 80 years (169) n (%)	Total (number, %)
Refractive error*	595 (80.84.)	313 (85.29)	125 (76.22)	1,033 (81.53)
Cataract	508 (57.27)	349 (88.13)	156 (92.31)	1,013 (69.77)
Glaucoma	140 (15.78)	111 (28.03)	67 (39.64)	318 (21.90)
Dry eye, MGD	66 (4.54)	39(7.6)	18(8.0))	123 (8.5)
Retinal breaks, retinal holes, macular hole	47 (5.30)	37 (9.34)	18 (10.65)	100 (6.89)
Epiretinal membrane (ERM)	32 (3.61)	32 (8.08)	21 (12.43)	85 (5.85)
Diabetic retinopathy (DR)	30 (3.38)	12 (3.03)	27 (15.98)	69 (4.75)
Age-related macular degeneration (AMD)	17 (1.92)	14 (3.54)	29 (17.16)	60 (4.13)
Myopic macular degeneration (MMD)	6 (0.47)	7 (0.55)	3 (0.24)	16 (1.26)

*Refractive error calculated sample size 1,267 (60-69 years: 736, 70-79 years: 367 and ≥ 80 years:164)

Table 3 Visual Impairment in the elderly (per 1,000) by presenting visual acuity (PVA) and best corrected visual acuity (BCVA)

Visual impairment	VA	60-69 years		70-79 years		80 years and more		Total:1,000
		Male	Female	Male	Female	Male	Female	
Unilateral Blind	PVA	7(12.6)	4(6.6)	6(27.6)	5(16.9)	2(17.5)	3(27.3)	27(18.6)
	BCVA	2(3.6)	1(1.6)	3(13.8)	-	2(17.5)	3(27.2)	11(7.6)
Bilateral Blind	PVA	1(1.8)	3(4.9)	-	2(6.7)	2(17.5)	1(9.1)	9(6.2)
	BCVA	-	-	-	1(3.4)	-	-	1(0.7)
Unilateral MSVI	PVA	39(70.4)	30(49.4)	19(87.6)	20(67.6)	12(105.2)	8(72.7)	128(88.1)
	BCVA	11(19.8)	4(6.6)	5(23.0)	11(37.2)	4(35.1)	8(72.7)	43(29.6)
Bilateral MSVI	PVA	23(41.5)	31(51.1)	16(73.7)	12(40.5)	8(70.1)	11(100)	101(69.56)
	BCVA	3(5.4)	6(9.9)	1(4.6)	4(13.5)	1(8.7)	1(9.0)	16(11.0)
Low vision in best seeing eye and blind in fellow eye	PVA	3(5.4)	3(4.9)	-	3(10.1)	2(17.5)	4(36.4)	15(10.3)
	BCVA	1(1.8)	-	-	1(3.4)	-	-	2(1.4)

PVA= Presenting visual acuity
BCVA= Best corrected visual acuity

Table 4 Causes of visual impairment in the elderly (per 1,000) with visual impairment using presenting visual acuity (PVA) and best corrected visual acuity (BCVA)

Eye diseases causing Visual Impairment	VA	Refractive error	Cataract	AMD	MMD	DR	ERM	RD	Glaucoma	Total
Unilateral blind	PVA	-	4	4	2	-	-	4	1	15
	BCVA	1	-	3	1	-	-	2	2	9
Bilateral Blind	PVA	-	1	1	3	-	2	-	2	9
	BCVA	-	-	-	1	-	-	-	-	1
Unilateral MSVI	PVA	79	19	4	1	2	2	2	5	114
	BCVA	2	19	4	1	3	4	1	5	39
Bilateral MSVI	PVA	68	19	2	1	-	3	2	3	98
	BCVA	1	6	-	3	-	1	3	1	15
MSVI in best seeing eye and blind in fellow eye	PVA	4	7	2	1	-	-	-	-	14
	BCVA	-	2	-	-	-	-	-	-	2

The rate of visual impairment in the elderly per 1,000 persons using PVA and BCVA are shown in Table 3. By using PVA, blindness and MSVI were 6.19 and 69.56 per 1,000 persons. By using BCVA, blindness and MSVI were 0.69 and 11.0 per 1,000 persons respectively and eye diseases causing visual impairment are shown in Table 4.

6. Discussion

A previous population-based study of visual impairment in Thailand in 2007 (Jenchitr, & Raiyawa, 2012) found prevalence of blindness and MSVI to be 0.56% and 2.61% respectively. The causes of blindness were Cataract 51.64%, Glaucoma 9.84%, AMD 6.56%, Corneal disease and corneal scar4.92 %, DR 2.46%, URE 1.64%. The causes of MSVI were Cataract 56.61%, Glaucoma 10.41%, AMD 3.88%, Corneal disease and corneal scar.1.23%, DR 2.46% and URE 14.11%. In a 2014 Rapid Assessment of Avoidable Blindness (RAAB) population-based study of those age 50 and above (Isipradit et al., 2014) found that blindness, SVI and MVI were 2.61%, 1.3% and 12.6 % respectively. The causes of blindness were Cataract 69.7%, Glaucoma 4%, AMD 2.0%, Corneal diseases and corneal scar 2.0%, DR 5.1% and URE4.0%.

In this study among the elderly patients attending university eye clinic, the prevalence of blindness and MSVI were less as 0.69 per 1,000 and 11.02 per 1,000 populations. MMD was the only cause of blindness. The causes of MSVI were Cataract 37.5%. Glaucoma 12.5%, MMD 8.75%, RD 18.75%; ERM 6.25% and URE 6.25%. No significant associations were found by age group or by gender for bilateral blindness or bilateral low vision using either presenting visual acuity or best corrected visual acuity (Table 5).

Table 5 Statistic clinical significance in different types of visual impairment

Visual impairment	Classify by type of visual acuity	Statistical significance	*p*
Bilateral Blindness	Presenting Visual Acuity	In age group	0.125
		In gender	0.521
	Best Corrected Visual Acuity	In age group	NA*
		In gender	NA*
Bilateral Low vision	Presenting Visual Acuity	In age group	0.054
		In gender	0.866
	Best Corrected Visual Acuity	In age group	0.920
		In gender	0.242

*No statistic difference for bilateral blindness using best corrected visual acuity due to there was only one case

Table 6 Comparison of findings of eye diseases in the elderly across selected studies

Year	County	Method, Population	Visual impairment (%)		Causes of visual impairment (%)
			Blindness	Low vision	
2004	Taiwan (Hsu et al., 2004)	Population based study ≥65 years	0.59%	2.94%	Cataract 41.7% MMD 12.5% AMD10.4%
2009	Korea (Yoon et al., 2011)	≥60 years,Cross-sectional survey, nation–wide	In 60-69 years visual impairment1.2% (M: F=0.9:1.5) In 70 years and more, visual impairment 3.8% (M: F=2.9-4.4) In over 65 years, blindness was 0.2±0.1% and no gender difference		Over 60 years, 80.5±1.3% had cataract and related to increasing age.
2010	Japan (Yamada et al., 2010)	≥ 40 years	0.15%	1.28%	Glaucoma 24.3% DR 20.6% Degenerative myopia 12.2% ARMD 10.9% Cataract 7.2%
2012	China (Li et al., 2012)	≥ 50 years, Rural China	3.59%(PVA) 2.88%(BCVA)	15.22%(PVA) 7.75%(BCVA)	Causes of blindness (BCVA) Cataract70.5% Corneal opacity8.2% Glaucoma 6.6% Causes of low vision (PVA) Cataract 53% Uncorrected refractive error 22%
2021	China (Zou et al., 2021)	China Study used data from national censuses	2.2%(PVA) 2.3% (BCVA)	10.9%(PVA) 5.4% (BCVA)	Cataract Macular degeneration Glaucoma
2022	India (Vashist et al., 2022)	A cross sectional, population-based survey≥50 years.	1.99%Blind	26.68%Low vision	Cataract 66.2% Corneal opacity 8.2% Cataract surgical complications 7.2% Posterior segment disorders 5.9% Glaucoma 5.5%

Visual impairment is a health burden in every country and 80% is due to preventable causes (Pascolini, & Mariotti, 2012). In this study, the major causes of visual impairment were cataract and follow by vitreoretinal diseases. The only cause of bilateral blindness was MMD. Cataract was the most common cause of MSVI (37.5%) followed by MMD (18.75%), RD (18.75%), glaucoma both primary and secondary (12.5%), ERM (6.25%) and URE (6.25%). In 2007, population based national survey, MSVI came from cataract 56.6%, glaucoma 10.4% and URE 14.1% 14.1%. Anterior segment eye diseases as dry eye, which are common in the elderly (Pray, 2009), were found in 20% in the group of 45 years and older and increased four-fold in age group of 65 years and above.

From this study, the emerging cause of visual impairment was MMD. MMD is more common in Asia (6.8-21.6%) especially in Southeast Asia compared non-Asian countries (2.0%-2.3%) (Wong,

& Saw, 2016). These findings correspond to the prevalence of myopia in urban area of East Asia (25-40%) which differed from Western Europe and USA (20-35%) (Matsumura et al., 2019).

In Table 6, different eye diseases and visual impairment were shown from different countries. Study from Taiwan (Hsu et al., 2004) in 65-91 years old population (mean 72.2), found that 0.59% were blind and 2.94% had MSVI. The visual impairment was increasing as the population were older but no gender different. The causes of visual impairment were from cataract (41.7%) MMD (12.5%) and AMD (10.4%) which were in common as well-develop country except MMD which were not found in European countries but was found in Thailand (Table 4).

In Korea in 2009 (Yoon et al, 2011) the 60 years and above population which is 22.3% of survey population, 5% of visual impairment were found which cataract was the major cause (80.5%). Visual impairment was increasing as the population aging but no gender difference was noted.

Study of visual impairment in Japan (Yamada et al., 2010) 11.5% of blindness and 88.5% of MSVI was due to glaucoma (24.3%), DR (20.6%), degenerative myopia (12.2%), AMD 10.9%, and cataract (7.2%). These finding differed from China (Li et al., 2012; Zou et al, 2021) and India (Vashist et al., 2022) which cataract was the most common finding of visual impairment.

This study was the first study of visual impairment in the elderly in Thailand. Emerging eye disease that causes visual impairment is MMD. It causes blindness by using the best corrected visual acuity, with refractive error -10.00 D and -7.00 D, and 30.84 mm axial length elongation. MMD has been reported as cause of visual impairment in Thai children (Wongkittirux, 2012) but has not yet been reported in Thai adults or Thai elderly. Patients in this study were the elderly which pay more attention to their eye health and had all the treatment of simple eye diseases and anterior segment eye diseases, so posterior segment eye diseases which difficult to detect and more complicate for treat were left. In the next population-based survey, posterior segment eye diseases will be expected to be responsible for a higher proportion of vision impairment.

7. Conclusion

This study was the first study of visual impairment in the elderly in Thailand. The study used definition of WHO (Vaishali, & Vijayalakshmi, 2020). By using BCVA, the prevalence of blindness and MSVI were 0.69 per 1,000 persons and 11.02 per 1,000 respectively, and caused by vitreoretinal diseases, glaucoma and only 1 case of refractive error. Compared to visual impairment classified by PVA, visual impairment in the same group of population, it was found that 68 cases (26.56%) of refractive error were the cause of MSVI in both eyes (Table 4). This showed that 54.5 % of patients attending eye clinic with PVA had uncorrected refractive error or had eyeglasses that did not correct the refractive error properly. Those presenting to the RSU eye clinic tend to be middle income and upper income urban residents who have easy access to quality eyeglasses. If all refractive errors were corrected, the numbers of those with presenting vision impairment would be substantially less, leaving vitreoretinal diseases as the major cause of visual impairment.

Visual impairment in the elderly attending the Rangsit University Eye clinic varied from results found in previous population-based studies. Eye diseases as cataract and refractive error are still found but less prevalent and most causes of visual impairment were due to more difficult to treat diseases. The group of posterior segment eye diseases are expected to be more prevalent in the future (Saaddine et al., 2008; Rein et al., 2009). Optometrists must not only pay attention to refraction and binocular vision, but also must be prepared to conduct examinations to screen, detect and refer eye diseases. The government should provide eye care personnel for quality refraction and eye disease screening. The screening unit should be based in community hospitals. Finally, optometrists must remain up to date on the management and control of myopia and myopic macular degeneration. Optometrists should routinely refer to ophthalmologists as needed for early diagnosis and treatment of eye diseases in the elderly.

8. The limitation of this study

As many elderly have mobility limitations, eye examinations for the elderly can take longer and require more personnel. Mostly the elderly are unable to drive, so their children or caretakers have to escort them to the examination and lack of availability of an escort may be responsible for lack of follow up. Some of patients with glaucoma and corneal diseases with central scotoma, and other problems may lead to incomplete eye examinations.

The major limitation of this study is that the population examined was not representative of the general population in Thailand, thus findings may only apply to middle and high income elderly living in central Bangkok.

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