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Clinical and demographic characteristics of patients with neuro-ophthalmological disorders starting later in life

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Abstract

Aim: To determine the demographic, etiological, and clinical features and treatment modalities of patients with neuro-ophthalmological disorders starting at a later age.

Materials and Methods: We retrospectively reviewed the clinical data related to the neuro-ophthalmology patients who presented at the geriatric age at two tertiary eye care referral centers from 2004 to 2022.

Results: Of the 2,127 patients who applied to the Neuro-Ophthalmology Department during this period, 162 (7.6%) were ≥ 65 years old at the time of diagnosis, and their data were analyzed. The mean age at the onset of the disease was 73.2 ± 6.7 (65–95) years, and the mean follow-up time was 1.1±0.4 (1-3) years. Non-arteritic anterior ischemic optic neuropathy (NAAION) (n=85, 52.5%), isolated cranial nerve palsies (n=28, 17.3%), and cerebral vascular disorders (CVD) (n=14, 8.6%) were the most frequent diagnosis. The most common symptoms were as follows: sudden visual loss in 79 (48.8%), diplopia in 31 (19.1%), and blurred vision in 21 (13%) cases. The most common accompanying systemic disease was hypertension (HT) and diabetes mellitus (DM) in 31 (27.4%), followed by HT in 29 (25.7%) cases. There was no accompanying systemic disease in 49 (30.2%) patients. The diagnosis of NAAION and AAION resulted in poor visual outcomes, while CVD presented with homonymous hemianopsia.

Conclusion: NATION and CVD were the most common age-related neuro-ophthalmological disorders that cause visual acuity loss and a visual field defect at an advanced age. Identifying these disorders and managing the visual problems are essential to protect the patient's quality of life.

Introduction

As the mean life expectancy continues to rise, the elderly population is increasing, and age-related disorders are becoming more common. It is expected that a quarter of the population in the developed world will be over 65 years of age by 2030 [1], and 1 in 6 people globally will be over 65 years old in 2050, according to World Population Prospects 2019 [2]. Therefore, improving health care services for older adults is becoming increasingly necessary.

Neuro-ophthalmological disorders range from life-threatening intracranial or systemic disorders to congenital disc anomalies. The decreased quality of life resulting from physical disabilities such as cognitive impairment, neurological disorders, and hearing loss becomes more challenging to manage with the addition of neuro-ophthalmological disorders that may cause visual acuity (VA) loss and visual field defects in the elderly. Identifying these disorders and managing the visual problems may be essential to protecting the patient's quality of life. The risk factors associated with age may result in clinical patterns different from those seen at a young age. Racial or ethnic origin, regional customs or cultural behavior, distinct social and economic conditions, the development level of countries, and limited entrance to healthcare centers may also result in variability in the diagnoses of neuro-ophthalmological disorders [3, 4]. Limited information has been presented about the various clinical patterns of neuro-ophthalmological disorders in the elderly [5].

This current has analyzed the causes, characteristics, and the natural course of neuro-ophthalmological diseases in geriatric subjects who presented at the neuro-ophthalmology specialty clinics of two tertiary referral centers in Turkey.

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Materials and Methods

We retrospectively analyzed the medical records of geriatric patients at the time of diagnosis who applied to Neuro-ophthalmology Departments of Ulucanlar Eye Hospital and Ankara Yıldırım Beyazıt University Faculty of Medical School between 2004 and 2022. The study protocol was confirmed by the Ankara City Hospital's Ethics Committee (number: E-22–2969) and conducted with the Declaration of Helsinki principles.

A comprehensive clinical history was taken from each subject. The demographic and clinical data were recorded. The age of onset of the disease, sex, laterality of ocular involvement, etiology, symptoms at presentation, clinical findings, follow-up time, the best-corrected visual acuity (BCVA) with the Snellen chart at the first and final visits, and associated systemic diseases were recorded. The exclusion criteria were patients with concomitant ocular diseases such as cataract, macular degeneration, glaucoma, and retinopathy that could decrease the visual acuity or the visual field test.

During the neuro-ophthalmological examination, Ishihara's pseudo-isochromatic color vision chart was used for color vision. Pupillary light reflexes were evaluated using a penlight to find relative afferent pupillary defect (RAPD). Anterior segment and dilated fundus examination were performed. Anterior segment and fundus photography and visual field testing (30-2 or 24-2 visual field test by automatic perimetry or a confrontation test if automated testing could not be done due to patient age or uncooperative) were also performed. B scan ultrasonography, fluorescein angiography, and optical coherence tomography were conducted when indicated. Patients with a suspected intracranial or orbital lesion, tumor, brain infarction, aneurysm, and sinus thrombosis were evaluated with brain magnetic resonance imaging (MRI), orbital MRI, diffusion MRI, MR angiography, and/or MR venography. In addition, diagnostic tests such as lumbar puncture (LP) were performed by a neurologist as necessary.

The BCVA was recorded at the first and final visit, and the change in VA was classified into 3 groups according to the Snellen chart: increased VA ($\geq$3 lines), decreased VA ($\leq$3 lines), and no change (VA changes of 0-2 lines). According to the American criteria, low vision was defined as a visual acuity $<$20/40 and $>$20/200 in the eye with better vision. In comparison, blindness was accepted as a VA less than or equal to 20/200 in the eye with better vision [6]. We evaluated the final BCVA according to these criteria.

The diagnosis and follow-up visits of the elderly patients were approved by two specialist clinicians (SK, PN) at the Neuro-Ophthalmology Departments.

For the diagnosis of non-arteritic anterior ischemic optic neuropathy (NAAION), the inclusion criteria were based on the study by Hayreh et al. [7] and included the following: 1. A history of sudden visual acuity loss with no other ocular, systemic, or neurological disease that could affect or explain the patient's visual symptoms; 2. The presence of edema in a segment or all of the optic nerve head; 3. No neurological, systemic, or ocular disorder that could be the cause of the optic disc edema (ODE); 4. Spontaneous resolution of ODE within 4-6 weeks; 5. Presence of optic disc-related visual field defects.

Following systemic query and the evaluation of clinical findings, patients suspected of giant cell arteritis and those aged 55 or over with a preliminary diagnosis of ischemic optic neuropathy underwent complete blood count, erythrocyte sedimentation rate (ESR), and C- reactive protein (CRP) tests. Those with an ESR $\geq$ 40 mm/hour and CRP $\geq$ 5 mg/l were scheduled for a temporal artery biopsy when clinically indicated.

The pupils were checked for size, shape, and light reflexes. The pupillary diameter was measured while patients were instructed to look at a target 6 meters away under bright and dim light in order to assess anisocoria by using a pupil gauge chart. A difference $>$ 0.5 mm between the pupillary diameters was accepted as anisocoria. If present, ptosis was graded and measured with a ruler using the margin-to-reflex distance, the distance between the margin of the upper lid to the central corneal reflex, and compared with the other side. The ocular deviation was evaluated with the cover-uncover test and alternating cover test. Extraocular eye movements were recorded in the nine cardinal positions and recorded with the Hess screen. The diagnosis of pupillary abnormalities has been described in another study [8]. To identify the causes of Horner syndrome, we requested cranial and neck MRI, MRI angiography, and enhanced thoracic computed tomography (CT) scanning if needed.

Traumatic optic neuropathy was determined as a history of direct or indirect ocular and head trauma and optic nerve dysfunction, including reduced visual acuity, RAPD, or dyschromatopsia, and other causes could not clarify that. Toxic optic neuropathy (TON) refers to visual acuity loss due to optic nerve damage caused by a toxin. It was diagnosed with bilateral vision loss, papillomacular bundle damage, central or cecocentral scotoma, and decreased color vision. Thyroid function tests and thyroglobulin antibody levels were requested as regards thyroid ophthalmopathy.

The clinical and etiological approach included referring our patients to the ENT and neurology departments and internal medicine and cardiology specialists to evaluate the systemic risk factors. During the etiological investigation, vascular reasons were defined as accompanying diabetes mellitus (DM), hypertension (HT), and secondary vascular microangiopathy developing due to atherosclerotic disorders as a result of hypercholesterolemia and/or hyperlipidemia [9]. Patients with no additional pathology on imaging and no vasculopathic risk factor were defined as idiopathic.

Topical brimonidine tartrate [10] three times a day from the initial period until six months was completed was used in the affected eye together with coenzyme Q10 to use its neuron-protective effect in the NAAION cases [11]. As regards the patients with a diagnosis of NAAION, steroid treatment was administered following patient consent in the form of intravenous corticosteroids for 3 days at a dose of 1000 mg/day, followed by oral methylprednisolone at a dose of 64 mg/day to be discontinued within the first month, or oral methylprednisolone treatment by itself according to the protocol of the study by Hayreh et al. [7], for those patients with a BCVA $\leq$20/200 and especially

if second eye involvement was present and if there were no systemic obstacles.

Statistical analysis

The statistical analysis was performed using the IBM SPSS software for Windows, version 22 (Armonk, NY: IBM Corp.). The mean±standard deviation was used for the continuous variable and frequencies for the categorical variables.

Results

We identified 162 (7.6%) patients among the 2,127 neuro-ophthalmological patients aged ≥ 65 years who presented to the Neuro-Ophthalmology Clinic. The mean of onset was 73.2±6.7 years (65–95 years), and the mean follow-up time was 1.1±0.4 years (1 to 3 years). All subjects were Turkish Caucasians. There were 68 (42%) females and 94 (58%) males. The presentation was with bilateral involvement in 35 (21.6%) and unilateral involvement in 126 (77.8%), while 1 (1.2%) patient did not have ocular involvement. Table 1 is summarized the distribution of sex, eye involvement, and age of onset for neuro-ophthalmological disorders in older patients.

One hundred thirteen patients (69.8%) had at least one accompanying disease, and 56 (34.6%) had two or more. The most common accompanying systemic disease was HT and DM in 31 (27.4%) cases, followed by HT in 29 (25.7%) cases. There was no accompanying systemic disease in 49 (30.2%) patients. The distribution of the accompanying systemic diseases is shown in Table 2. The most common diagnoses of the subjects and the accompanying systemic diseases are presented in Table 3.

The most common symptoms were sudden visual loss in 79 (48.8%) patients, followed by diplopia in 31 (19.1%) and blurred vision in 21 (13%). Other symptoms were as follows: visual field constriction in 10 (6.2%), proptosis in 7 (4.3%), ptosis in 5 (3.1%), blepharospasm in 3 (1.8%), retroorbital pain in 3 (1.8%), headache in 2 (1.2%), and photophobia in 1 (0.6%).

The visual acuity (VA) result of the affected eyes is shown in Table 4. Compared to the first VA, the final VA was increased by at least 3 lines of Snellen visual acuity in 12 (6.1%) eyes. The VA remained unchanged in 175 (89.3%) eyes and decreased in 9 (4.6%) eyes. Decrease of VA was affected by NAAION in 6 (66.7%) eyes, cerebral vascular disorders (CVD) in 2 (22.2%) eyes, and optic neuritis with sixth nerve palsy due to the varicella-zoster virus (VZV) in 1 (11.1%) eye.

The most common diagnosis in the geriatric subjects was NAAION. Both eyes were affected in 6 (7.1%) cases, with unilateral involvement in 79 (92.9%) cases. Twelve of the cases presented with Pseudo-Foster Kennedy Syndrome at the initial visit. Despite the absence of systemic disease at the time of diagnosis, 7 (8.2%) cases were diagnosed with HT and hypercholesterolemia, and 2 (3.3%) with HT after internal medicine and cardiology consultation. No additional systemic disease was observed in 26 (30.6%) of the subjects at the time of diagnosis and during follow-up. However, in 17 (65.4%) of these cases, the optic nerve head was characterized with a 'disk at risk' appearance in the unaffected eye. The VA outcomes of the cases with NAAION at the initial visit were ≤0.1 in 40 (44%) cases, 0.2 to 0.4 in 20 (22%) cases, and ≥ 0.5 in 31 (34%) cases. At the final visit, VA was ≤ 0.1 in 24 (26.4%) cases, 0.2 to 0.4 in 10 (11%) cases and ≥ 0.5 in 57 (62.6%) cases. When we compared the first and final VA, the VA was increased by at least 3 lines on the Snellen chart in 8 (8.8%) eyes, unchanged in 77 (84.6%) eyes, and decreased in 6 (6.6%) eyes.

Temporal arteritis was diagnosed in 7 (4.3%) patients who complained of sudden VA loss and whose VA level was between CF and NLP. Temporal artery biopsy results were consistent with the diagnosis in all patients. The condition was not diagnosed until the other eye was affected in 2 (28.6%) cases with bilateral involvement.

While multiple cranial nerve palsies were not observed in our cases, isolated 6th nerve palsy (n=13, 46%) was the most common involvement, followed by 3rd (n=11, 42.3%) and 4th cranial nerve palsies (n=4, 25%). The main cause of ocular motor cranial nerve palsy was a vascular disorder. However, no risk factors were found in 2 patients in both isolated cranial nerve palsy groups, and they were accepted as idiopathic. Complete 3rd nerve palsy with pupillary involvement was observed in 3 (27.3%) of the 3rd nerve palsy cases, and incomplete 3rd nerve palsy with the pupil spared was observed in 3 (27.3%) cases. Brain MRI and MRI angiography were performed for a possible underlying aneurysm and tumor-related compression, but no additional pathology was found. In these cases, DM and HT coexisted as systemic diseases. Therefore, it was accepted that the patients had pupillary involvement in oculomotor nerve palsy associated with DM. Additionally, an anisocoria of more than 2 mm was not observed in any patient. The pupil normalized in these patients after 3 weeks. Except for malignant causes, all cases of cranial nerve palsy resolved within the first 3 months. During this period, occlusion therapy was implemented for patients disturbed by diplopia.

Five (35.7%) of the patients with CVD presenting with headache, visual field loss, and neurological symptoms (including ataxia, weakness, loss of sensation, nystagmus, and consciousness changes) were diagnosed with acute ischemic stroke at the time of diagnosis, while the remaining 9 (64.3%) cases were in the chronic phase and were referred to our clinics by the Neurology department after the patients complained of a narrowed visual field. The patients were evaluated by imaging with Diffusion MRI, brain MRI, and MRA. The lesions were in the occipital lobe in 8 cases (57.1%) and the optic radiation in 5 (35.7%) cases. Seven (50%) of these cases had left-sided, and 6 (42.9%) had right-sided homonymous hemianopsia. One (7.1%) patient complained of weakness and dysarthria, a visual field defect, and vertical gaze palsy characterized by homonymous sectoranopsia had LGN damage due to thalamic infarction. The VA did not decrease except in 2 patients, but the visual fields did not recover in any patient during the follow-up time in patients with CVD.

Medical treatment during the follow-up for elderly patients is summarized in Table 5.

Table 1. The specific diagnosis at the geriatric age and the distribution of gender, ocular involvement, and the mean age at onset.

Diagnosis	No. of patients (%)	Gender (F/M) (%)	Unilateral (n,%)	Bilateral (n,%)	Age at onset, years[s]
AION	92 (56.8%)				
Non-arteritic AION	85 (92.5%)	31 (36.5%)/ 54(63.5%)	79 (92.9%)	6 (7.1%)	71.8±5.8 (65-97)
Arteritic AION	7 (7.5%)	4(57.1%)/ 3(42.6%)	5 (71.4%)	2 (28.6%)	78.4±2.9 (74-81)
Cranial Nerve Palsies	28 (17.3%)				
4th nerve palsy	4 (25%)	2 (50%)/ 2(50%)	4 (100%)	–	70.3±3.8 (67-74)
3rd nerve palsy	11 (42.3%)	5 (45.5%)/ 6(55.5%)	11 (100%)	–	76.5±7.5 (65-92)
6th nerve palsy*	13 (46.4%)	5 (38.5%)/ 8(61.5%)	13 (100%)	–	74.1±7 (66-89)
Cerebral Vasc. Disorder	14 (8.6%)	6 (42.9%)/ 8(57.1%)	–	14 (100%)	76.8±9.3 (65-93)
Optic neuropathy	7 (4.3%)				
Toxic ON	5 (71.4%)	2 (40%)/ 3(60%)	2 (40%)	3 (60%)	70 (65-76)
Traumatic ON	2 (28.6%)	1 (50%)/ 1(50%)	2 (100%)	–	72.5 (72-73)
Thyroid Ophthalmopathy	5 (3.1%)	3 (60%)/ 2(40%)		5 (100%)	75 (65-86)
Orbital Tumor	4 (2.5%)	2 (50%)/ 2(50%)	4 (100%)	–	83 (79-92)
Essential Blepharospasm	3 (1.8%)	2 (66.7%)/ 1(33.3 %)	–	3 (100%)	67 (65-69)
Pupillary Anomalies	2 (1.2%)				
Horner Syndrome	1 (50%)	1 (100%)	1 (100%)	–	65
Adie Pupilla	1 (50%)	1 (100%)	1 (100%)	–	76
Fischer Syndrome	2 (1.2%)	2 M (100%)	–	2 (100%)	75 (72-78)
Malignancy	2 (1.2%)	2 F (100%)	1 (50%)	–	71 (66-77)
Seconder IIH	1 (0.6%)	1 M (100%)	–	1 (100%)	79
Non-organic VFL	1 (0.6%)	1 F (100%)	–	1 (100%)	67

AION: anterior ischemic optic neuropathy, Vasc: vascular, ON: optic neuropathy.
s: Mean±standard deviation (min-max), median (min-max), *: One of the patients had both 6th nerve palsy and optic neuritis due to herpes zoster ophthalmicus.

Table 2. Distribution of concurrent systemic diseases of the patients.

Disease	n, (%)
HT	29 (25.7%)
DM	12 (10.6%)
DM + HT	31 (27.4%)
HT+ hypercholesterolemia	7 (6.2%)
Malignancy	5 (4.4%)
Thyroid disease	4 (3.5%)
DM + HT + hypercholesterolemia	2 (1.8%)
DM + IHD	3 (2.7%)
DM + HT + IHD	3 (2.7%)
DM + IHD + CRF	3 (2.7%)
DM + HT + arrhythmia	3 (2.7%)
HT + IHD	2 (1.8%)
CRF	2 (1.8%)
HT + coronary bypass surgery	2 (1.8%)
Others*	5 (4.4%)

HT: Hypertension, DM: Diabetes Mellitus, IHD: Ischemic heart disease, CRF: Chronic renal failure, Others*: Carotid artery occlusion (n=1,0.8%), rheumatoid arthritis (n=1, 0.8%), gout disease (n=1,0.8%), tuberculosis (n=1,0.8%), depression (n=1,0.8%).

Discussion

This study reports on the demographics, clinical features, and natural course of neuro-ophthalmological diseases in geriatric patients. The most common diagnosis was NAAION. The main cause for referral to the neuro-ophthalmology department was a sudden visual loss, followed by ocular motor cranial nerve palsies and double vision. The prevalence and causes of visual acuity loss in ocular diseases at an advanced age have been investigated in many studies. Age-related macular degeneration, cataract, and glaucoma are the major causes of visual impairment, and their prevalence rises with age [12, 13]. To our knowledge, there is only one study to evaluate neuro-ophthalmological diseases in geriatric patients [5]. Similar to our study, they found that the most common cause of permanent visual impairment was NAAION [5].

Despite well-characterized clinical signs and manifestations, the pathophysiology of NAAION is still unknown. In a recently published meta-analysis report, male gender, HT, hyperlipidemia, diabetes mellitus (DM), coronary heart disease (CHD), sleep apnea, factor V Leiden heterozygous state, and the cardiovascular drug history were considered as the main risk factors [14]. The ischemic optic neuropathy decompression trial (IONDT) has found at least one vasculopathic risk factor in 60% of NAAION patients, in addition to hypertension in 47% and DM in 24%

Table 3. The most common diagnosis and accompanying systemic diseases of the subjects.

Diagnosis (n)	Systemic disease (n)
AION (n=92)	
NA-AION (n=85)	No systemic disease (26), HT(19), DM+HT (15), DM (7), HT+hypercolesterolemia (7) DM+HT+IHD (3), DM+CRF+IHD (2), HT+IHD (2), DM+IHD (2), CRF (1), Carotid artery occlusion (1)
A-AION (n=7)	Temporal arteritis (n=8)
Cranial nerve palsies (n=28)	
6th nerve palsy (n=13)	No systemic disease (2), HT (3), DM (2), DM+HT (1), herpes zoster oftalmicus (2), DM+HT+hypercholesterolemia (1), CRF(1), malignancy (1)
3rd nerve palsy (n=11)	No systemic disease (2), DM+HT (4), DM (1) HT (1), HT+coronary bypass surgery (1), malignancy (1), DM+HT+hypercholesterolemia (1)
4th nerve palsy (n=4)	No systemic disease (2), DM (1), HT (1)
Cerebral vascular disorder (n=14)	DM+HT (10), DM+HT+arrhythmia (2), HT (1), DM+IHD+CRF (1)

Table 4. The visual acuity levels of the 196 affected eyes at the initial and final visit in patients diagnosed with the neuro-ophthalmological disease at the geriatric age.

Initial visit visual acuity	Final visit visual acuity			
	≤ 0.1	0.2– 0.4	≥ 0.5	Total n (%)
≤ 0.1	43	1	7	51 (2%)
0.2–0.4		28	4	32 (%)
≥ 0.5	1		112	113 (%)
Total n (%)	44 (%)	29 (%)	123 (%)	196 (100%)

[15]. A risk factor was present in 69.4% of our cases, and the most common accompanying vascular disorders were HT (32.2%) and DM and HT together (25.4%).

Despite the many experimental and clinical studies in the literature, it cannot be expected to modify the clinical course of the disorder and create an effective treatment approach. A new systematic meta-analysis study has revealed no effective treatment, including steroids, oxygen, steroid plus erythropoietin (EPO), levodopa/carbidopa, memantine, and heparin-induced extracorporeal LDL/fibrinogen precipitation (HELP) therapies [16]. In addition to medical treatments, the literature contains surgical treatments such as optic nerve decompression surgery and transvitreal optic neurotomy [17, 18]. A comparison of our cases' baseline and final BCVA revealed no significant change in 84.6% of the eyes. The rate of contralateral eye involvement with NAAION within 5 years of the first eye has been reported as 15–20 % [19]. The 26.4% of our cases with monocular involvement and a BCVA of $<20/200$ could face blindness if the other eye is also involved. Based on the American criteria for blindness, 3.7% of the subjects that were diagnosed with AAION and NAAION had a visual acuity at the blindness level, and the percentage of low vision was 11.1% in those with a diagnosis of NAAION in this study.

The second most common diagnosis in geriatric subjects was cranial isolated ocular motor nerve palsy, while diplopia was also the second most frequent symptom at presentation in our study. Limitation of eye movements can be the first sign of pathologies related to cerebral disorders. The approach to the patient with ocular motor cranial nerve palsy is critical because of the impact of early diagnosis on mortality and treatment choices in pathologies related to an underlying aneurysm, cerebral tumor, or infarct. Ocular cranial nerve palsies in patients aged 50 years more develop due to microvascular ischemia forming in the nerve in the presence of atherosclerotic risk factors such as DM, HT, and hyperlipidemia [20, 21]. Some studies have reported isolated 6th cranial nerve paralysis [22, 23], while 3rd nerve palsy was more common in others [24, 25]. In our series, isolated 6th nerve palsy was the most common, with 46.4% and 77% of these patients having at least one vascular risk factor.

Table 5. Treatment methods of geriatric patients with neuro-ophthalmological disease.

Treatment methods	Diagnosis	Number of cases (n)
IV methylprednisolone + oral CS + oral antiaggregant	AAION	5
IV methylprednisolone + tocilizumab + oral antiaggregant	AAION	2
IV methylprednisolone + oral CS + topical brimonidine tartrate + CoQ10	NAAION	6
Oral CS+ topical brimonidine tartrate + CoQ10	NAAION	8
Topical brimonidine tartrate + CoQ10	NAAION	35
Topical brimonidine tartrate	NAAION	8
Oral antiaggregant	CVD NAAION Cranial nerve palsies (3rd and 6th)	14 10 6
IV acyclovir	6th cranial nerve palsy with optic neuritis	1
Botox	Essential Blepharospasm	1
Oral acetazolamide + anticoagulant	Secondary IHH	1

CS: Corticosteroid , CoQ10: Coenzyme Q10, AAION: Arteritic anterior ischemic optic neuropathy, NAAION : Non-arteritic anterior ischemic optic neuropathy, CVD: Cerebral vascular disease, IHH: Idiopathic Intracranial Hypertension.

Vision loss is generally associated with a diminished ability to carry out activities of daily living, a loss of independence, decreased social contact [26], and an increased risk of depression [27]. Reduced participation and activity loss are associated with an increased risk of functional and cognitive decline [28-32]. A relationship between cognitive disorders and visual impairment has been determined [33]. Fukuoka et al. have reported that dementia is not seen in elderly subjects without visual loss, while moderate to severe dementia develops in those suffering from a visual disorder [13].

With the decreased physical activities in advanced age, reading becomes more important. To read newspaper or TV subtitles, it is necessary to have a visual acuity of approximately 20/70 [34]. Visual field defects can also lead to reading difficulties. Stroke is the most frequent cause of homonymous hemianopia (HH) in adults [35]. Approximately stroke causes 52-70% of hemianopias, and 8-10% of stroke cases have permanent HH [36, 37]. In our series, permanent HH was encountered in 92.9% of the cases after stroke, and no significant improvement in the visual field was achieved in any of the cases during the follow-up time. In addition, subjects with HH have an irregular eye movement pattern, prolonged fixation reduced saccadic amplitude, and an increased number of regressive saccades, which can all result in poor reading [38]. Independent of the intensity of visual field damage, left-to-right readers with left HH have trouble finding the following line of text [38]. Fifty percent of our cases had left-sided HH.

Hemianopia can also cause difficulties in perceiving and navigating surrounding obstacles while walking. The result can be decreased orientation, an increased risk of falls, difficulty noticing any hazards or objects along the way, and difficulties when crossing the street while avoiding cars [35]. It has been reported that visual impairment, decreased contrast sensitivity, and constricted visual field in advanced age make the patient prone to falls, resulting in hip fractures [39]. Visual acuity impairment was significantly associated with two or more falls in older adults [40]. Falls are a significant problem and a major cause of death among the geriatric age [13]. Bone fractures due to falls are also the main cause of becoming bedridden [13].

Conclusion

In conclusion, blindness and visual impairment are the most substantial public health problems. The most common age-related neuro-ophthalmological diseases resulting in poor visual acuity and a visual field defect were NAAION and CVD in the present study. With longer life expectancy and consequent increase in the elderly population, these disorders will assume an increasing significance in the nation's public health. Due to the lack of effective treatment methods, primary health care centers should take a more active role in keeping the risk factors for neuro-ophthalmological diseases, including ischemic optic neuropathy and CVD, under control in the geriatric age. Identifying and managing these visual problems can significantly affect a patient's quality of life, and also taking precautions against any potential dangers. The results of this study can be used in developing healthcare services for the geriatric population, especially in developing countries.

Conflicts of interest

The authors declare that there is no conflict of interest and no proprietary interest in any of the materials mentioned in this article.

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Ethical approval

The present study was reviewed by Ankara City Hospital's Ethics Committee (number: E-22–2969) and the study was performed in accordance with the principles of the Declaration of Helsinki.

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