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Article

A Comparative Analysis of the Fear of Falling Between Glaucoma and Age-Related Macular Degeneration Patients From a Developing Country

Carla N. Urata[1], Livia S. Mazzoli[1], and Niro Kasahara[1,2]

[1] Irmandade da Santa Casa de Misericordia de Sao Paulo, Sao Paulo, Brazil
[2] Santa Casa de Sao Paulo School of Medical Sciences, Sao Paulo, Brazil

Correspondence: Niro Kasahara, Rua Sao Mauro, 292 Sao Paulo 02526-050, Brazil.
e-mail: niro.kasahara@fcmsantacasasp.edu.br

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Purpose: Falls are very prevalent in the older population. Visually impaired elderly patients are prone to falls as the result of visual loss and ageing. The purpose of the study was to compare the fear of falling (FoF) between primary open angle glaucoma (POAG) and age-related macular degeneration (ARMD) patients who live in a developing country.

Methods: This was a cross-sectional observational study. After a complete eye examination including measurement of best-corrected visual acuity, ophthalmoscopy, and automated visual field, all subjects completed the Fall Efficacy Scale International Brazil (FES-I-Brazil) questionnaire.

Results: The sample comprised 64 patients with POAG, 48 with ARMD, and 52 controls. All groups were matched for age, sex, comorbidity, and ethnic distribution. The FES-I score was 24.6 $\pm$ 8.7, 25.3 $\pm$ 6.3, and 24.2 $\pm$ 7.7 for glaucoma, ARMD, and controls, respectively ($P = 0.894$). A post hoc analysis comparing all subjects with advanced visual field defect (mean deviation [MD] < -12 dB) revealed a higher FES-I score in ARMD patients as compared to POAG ones (46.2 $\pm$ 16.8 and 24.0 $\pm$ 7.7 for ARMD and POAG, respectively, $P < 0.001$).

Conclusion: In this cohort of elderly subjects with eye diseases, the FoF was similar among groups; however, ARMD patients with more compromised visual field had higher FoF as compared to POAG patients and controls.

Translational Relevance: A high rate of fear of falling exists in ARMD patients with compromised visual field. This finding may be useful in developing multidimensional strategies to decrease fear of falling and improve quality of life in older persons living in a developing country.

Introduction

According to data from the World Population Prospects, the number of persons aged 60 or above is expected to more than double by 2050, 65% of the global increase will occur in Asia, 14% in Africa, and 11% in Latin America and the Caribbean.[1] Currently, 8.3% of the Brazilian population is older than 65 years and that figure is expected to increase.[2]

Falls are recognized as a major cause of death and a growing burden of disease worldwide, especially in older people.[3] In Brazil, 26.7% of the elderly hospitalizations are due to falls and that number reflects in higher morbidity and mortality rates.[4] Falls are not part of the natural ageing process. They are often the result of a collective and individualized set of over 400 risk factors. Falls are multifactorial, the culmination of various combinations of intrinsic and extrinsic factors.[5] Most of clinical studies and randomized trials in falls prevention were implemented in Western nations. Factors contributing to falls risk may vary between countries, on cultural differences and living conditions of the elderly.[6,7] Differences in extrinsic factors also exist, including the home and outdoor environment. Moreover, there can be differences in health services and systems, and

engagement of older people in these programs.[8] Therefore, interventional approaches recognized as effective in developed countries may not be effective in a developing community setting.[5]

Visually impaired elders are prone to falls as the result of both visual loss and ageing. The two most common ophthalmic diseases related to falls in senior patients are glaucoma and age-related macular disease (ARMD).[9] Primary open angle glaucoma (POAG) is a progressive optic neuropathy characterized by the loss of ganglion cells and their axons leading to an irreversible loss of visual field, thus increasing the fear of falling specially when the inferior hemifield is compromissed.[10,11] Moreover, as patients have limited vision field, bumping into objects becomes common and the risk of falls increases and so does the fear of falling. The fear of falling is then related to reduced physical activities and mobility and therefore reduced quality of life.[12]

ARMD is a degenerative disease that affects the macula of people above 50 years of age and can also lead to irreversible vision loss due to central scotoma. Nguyen et al.[13] have reported that the vision loss caused by ARMD was related to limitation of certain activities due to the fear of falling.

To the best of our knowledge, the fear of falling in the context of eye diseases such as POAG and ARMD has never been studied among patients who live in a developing country. Therefore, the aim of this study was to evaluate and compare the fear of falling among POAG, ARMD, and healthy subjects in the Brazilian population.

Methods

This was an observational cross-sectional study, reviewed and approved by the Committee on Human Research of the institution. All participants were patients seen at the Santa Casa de Misericordia de Sao Paulo Ophthalmology Clinic. The study complied with the tenets of the Declaration of Helsinki as amended by the 64th WMA General Assembly, Fortaleza, Brazil, October 2013 and the Resolution 466/12, National Council of Health, Ministry of Health, Brazil. All subjects signed the informed consent.

Study Population and Inclusion Criteria

In order to be included in the study, normal controls needed to meet the following inclusion criteria: age older than 50 years; best visual acuity (VA) 20/40 or better; no ocular disease except for early cataracts; a reliable Humphrey SITA standard 24-2 automated perimetry ($\leq$20% of fixation losses and $\leq$15% of false negative and positive errors) with normal mean deviation (MD) and pattern standard deviation (PSD) values.

POAG patients were included according to the following: presence of notch or concentric cup enlargement in the optic disc; disc hemorrhage or retinal nerve fiber layer defects; perimetric defects defined as a cluster of at least three nonedge points in a location typical for glaucoma, all of which are depressed on the pattern deviation plot at a $P < 5\%$ level and one of which is depressed at a $P < 1\%$ level on two consecutive fields and/or PSD at a $P < 5\%$ and/or glaucoma hemifield test (GHT) outside normal limits on a reliable exam; and opened angles on gonioscopy.

ARMD was defined by the presence of the following abnormalities in the macular area: soft drusen $\geq$ 63 μm, hyperpigmentation and/or hypopigmentation of the retinal pigment epithelium (RPE), RPE and associated neurosensory detachment, (peri)-retinal hemorrhages, geographic atrophy of the RPE, or (peri)retinal fibrous scarring in the absence of other retinal (vascular) disorders.[14]

Patients were excluded from the study if they have had incisional eye surgery within the last 6 months, ocular laser surgery within the last 4 weeks, or any other surgery or hospitalization due to nonocular cause for the past 3 months. Depressive or low cognitive function patients were also excluded from the study.

Procedures

All patients underwent a comprehensive ophthalmologic examination, including best-corrected VA measurement, slit lamp biomicroscopy, tonometry with Goldmann applanation tonometry (Haag-Streit AG, Switzerland), gonioscopy with a three-mirror lens OG3M (Ocular Instruments, Bellevue, WA), dilated fundoscopy using a 78 diopter lens (Volk Optical, Inc., Mentor, OH), and visual field test with HFV 750 (Carl-Zeiss Humphrey, Dublin, CA) SITA standard 24-2 using appropriated lens to correct refractive errors. The authors themselves did all examinations.

Cognitive functions were assessed by the Mini-Mental State Exam and depression symptoms were screened by the 4-Item Geriatric Depression Scale. Questionnaires were completed as an interview in an environment other than the ophthalmology office by an independent observer.

Table 1. Demographic Data, Clinical Features, and Fear of Falling Comparison Among Glaucoma, ARMD, and Control Group

	Glaucoma ($n = 64$)	ARMD ($n = 48$)	Control ($n = 52$)	*P* Value
Age (y)	66.6 ± 9.2	69.8 ± 9.3	63.4 ± 7.3	0.152
Sex F:M	36:28	26:22	29:23	0.254
Ethnicity				0.543
White	34	25	28	
Nonwhite	30	23	24	
Education level (at least high school degree)	11 (17.1%)	7 (14.5%)	10 (15.3%)	0.824
Yearly income (<US $25,000)	64 (100%)	47 (97.9%)	51 (98.0%)	0.521
No medical insurance	64 (100%)	47 (97.9%)	50 (96.1%)	0.303
Comorbidity				0.096
Arterial hypertension	38	31	19	
Diabetes	12	11	10	
Others	8	6	8	
VA (logMAR)				
Better eye	0.09 ± 0.11	0.09 ± 0.12	0.01 ± 0.05	0.02
Worse eye	0.33 ± 0.49	0.39 ± 0.60	0.15 ± 0.40	0.001
C/D				
Better eye	0.6	0.3	0.3	0.002
Worse eye	0.8	0.3	0.3	0.004
MD				
Better eye	−9.0 ± 8.6	−9.3 ± 7.7	−4.5 ± 3.9	<0.001
Worse eye	−14.9 ± 9.5	−13.2 ± 8.3	−5.2 ± 4.8	<0.001
PSD				
Better eye	5.6 ± 4.1	6.3 ± 3.5	5.4 ± 3.6	0.257
Worse eye	7.4 ± 3.9	6.7 ± 3.3	5.8 ± 4.1	0.19
FES-I	24.6 ± 8.7	25.3 ± 6.3	24.2 ± 7.7	0.894

F, female; M, male; logMAR, logarithm of the minimum angle of resolution; C/D, cup-to-disc ratio (median).

Fear of Falling Analysis

All subjects included in the study answered the Falls Efficacy Scale–International (FES-I) adapted and validated for Brazilian people (FES-I-Brazil).[15] This is a questionnaire developed to assess the fear of falling in 16 daily tasks. For each of these tasks, patients had to grade their fear of falling with only one of four possible answers: "not at all concerned," "a little concerned," "moderately concerned," or "very concerned." Each answer had a score from 1 to 4, respectively. Therefore, the final score could vary from 16 (no fear of falling at all) to 64 (extreme fear of falling). A final score above 23 points was considered a great fear of falling, as established by Delbaere et al.[16]

Statistical Analysis

The analysis of variance test was used to determine the differences among the groups for continuous variables, and the χ^2 test on a contingency table was used for categorical variables. Statistical analysis was conducted using the statistical programming language OpenEpi version 3.03a. We have set $P < 0.05$ as the significance level to reject the null hypothesis.

Results

The sample included 64 patients with POAG, 48 ARMD patients, and 52 controls. Table 1 depicts the clinical and demographic characteristics for each group. The low education level, low yearly income, and no medical insurance are distinctive of a developing country population. Sex, ethnicity, and comorbidity were evenly distributed among the groups. In the ARMD group, all patients had early and moderate disease: either any soft drusen (distinct or indistinct) and pigmentary abnormalities or large soft drusen with

Table 2. Demographic Data, Clinical Features, and Fear of Falling Comparison Among Glaucoma and ARMD Patients With Advanced Visual Field Defects (MD < -12 dB).

	Glaucoma ($n = 18$)	ARMD ($n = 13$)	Control ($n = 52$)	*P* Value
Age (y)	66.9 ± 11.5	72.0 ± 7.3	63.4 ± 7.3	0.275
Sex F:M	13:5	10:03	29:23	0.235
Ethnicity				0.051
White	10	7	28	
Nonwhite	8	6	24	
Education level (at least high school degree)	3 (16.6%)	2 (15.3%)	10 (15.3%)	0.082
Yearly income (>US $25,000)	18 (100%)	13 (100%)	51 (98.0%)	0.626
No medical insurance	18 (100%)	13 (100%)	50 (96.1%)	0.542
Comorbidity				0.994
Arterial hypertension	11	10	19	
Diabetes	5	6	10	
Others	4	5	8	
VA (logMAR)				
Better eye	0.12 ± 0.60	0.12 ± 0.12	0.01 ± 0.05	0.237
Worse eye	0.60 ± 0.62	0.49 ± 0.89	0.15 ± 0.40	0.059
C/D				
Better eye	0.8	0.3	0.3	<0.001
Worse eye	0.85	0.4	0.3	<0.001
MD				
Better eye	−20.8 ± 5.0	−10.5 ± 18.8	−4.5 ± 3.9	<0.001
Worse eye	−24.2 ± 5.6	−24.0 ± 6.1	−5.2 ± 4.8	<0.001
PSD				
Better eye	5.9 ± 3.1	6.4 ± 2.2	5.4 ± 3.6	0.591
Worse eye	9.2 ± 3.6	8.3 ± 3.2	5.8 ± 4.1	0.003
FES-I	24.0 ± 7.7	46.2 ± 16.8	24.2 ± 7.7	<0.001

F, female; M, male; logMAR, logarithm of the minimum angle of resolution; C/D, cup-to-disc ratio (median).

a large drusen area or large soft indistinct drusen in the absence of signs of late-stage disease. Most patients in the glaucoma group (34) had early disease, that is, visual field MD value > -6.0 dB in the better eye. The FES-I score was higher for ARMD patients (25.3 ± 6.3) as compared to POAG (24.6 ± 8.7) and controls (24.2 ± 7.7); the difference, however, failed to reach statistical significance ($P = 0.894$). A post hoc analysis comparing only subjects with advanced visual field defect (MD < -12 dB) revealed a higher FES-I score in ARMD patients as compared to POAG subjects (46.2 ± 16.8 and 24.0 ± 7.7 for ARMD and POAG, respectively, $P < 0.001$; Table 2).

Discussion

The fear of falling is an important concern among elderly people.[17] Previous studies have already shown an association between vision loss and reduced mobility in age related eye diseases.[18,19] In this study, the three groups—POAG, ARMD, and controls—were worried about falling. The results observed did not reach statistical significance. However, in a post hoc analysis comparing patients with MD worse than −12 dB, ARMD subjects showed higher fear of falling as compared to the other groups.

To the best of our knowledge, this was the first study that evaluated the fear of falling in Brazilian patients with POAG and ARMD. Macedo et al.[20] assessed the association between functional balance, visual functioning, and fear of falling in older Brazilian patients with cataracts. Using the Berg balance scale as the measure of postural balance, the authors reported a significant association in the bivariate analyses between balance and FES-I. Cataracts are very common in older patients and the vision loss caused by the disease can be overcome

by uneventful phacoemulsification. Conversely, the visual loss from POAG and ARMD is irreversible.[20]

The Falls Efficacy Scale-International, validated and adapted to the Brazilian elderly population (FES-I-Brazil), evaluates these group concern of falling in different daily situations.[15] All subjects included in the study completed the FES-I-Brazil, which contains 16 items scored on a four-point scale (1 = not at all concerned to 4 = very concerned). Therefore, the total score could vary from 16 to 64. Those who scored above 23 points were considered highly concerned about falling, as established by Delbaere et al.[16] The present study revealed that the fear of falling is a constant concern among the three groups. In that regard, aging by itself is probably a risk factor for fear of falling in older people living in a developing country, regardless of visual disabilities or eye disease. Another possible explanation is that visually impaired patients might learn to adapt to the new disability by paying extra attention when walking or adapting the home environment to their circumstances and, in time, the fear of falling may not be an issue any more. We have no information on how long the patients in the study were visually disabled to confirm this hypothesis.

Both control and POAG patients revealed similar fear of falling, although there was no statistical difference between the two groups (24.2 ± 7.7 and 24.6 ± 8.7, respectively, $P = 0.894$). Turano et al.[19] also found no significant difference in fear of falling among these groups (prevalence of fear of falling of 28% in the glaucoma group, and 23% in the control group, $P = 0.65$). In that study, the mean age for glaucoma patients was 65.1 years, comorbidities were not reported, and the fear of falling was assessed by a yes or no question: "Have you had a fear of falling in the last year?"—fear of falling was defined as being anxious or worried about falling or being frightened of falling. The mean age in our study was 66.6 years and the fear of falling was assessed by a more thorough validated instrument (FES-I). Ramulu et al.[21] applied a different questionnaire in a group of 60 glaucoma patients, mostly female (61.7%), comorbid number of 2.5 illnesses, and a mean age of 69.5 years. They analyzed the results using a Rasch model. In this model, the fear of falling was measured in logits and it revealed that glaucoma was associated with greater fear of falling ($\beta = -1.02$ logits; 95% confidence interval [CI]: −1.75 to 0.30; $P = 0.006$) compared to the controls ($\beta = -1.20$ logits; 95% CI: −1.87 to −0.53; $P = 0.001$). The authors also found greater fear of falling in patients with more severe vision field loss ($\beta = -0.52$ logits per 5 dB decrement in the better-eye visual field MD; 95% CI: −0.72 to −0.33; $P < 0.001$).[21] In our study, the glaucoma group had similar age, both genders were more evenly distributed (56.2% of females), and less comorbid illnesses (0.9). Even though glaucoma patients had worse MD values both in the best and worst eye compared to healthy subjects, both groups revealed similar fear of falling (Table 1). This could be due to the fact that the VA of the best and worst eye was similar in the POAG and control groups (0.09 ± 0.11 vs. 0.01 ± 0.05, $P < 0.02$ for the best eye and 0.33 ± 0.49 vs. 0.15 ± 0.40, $P < 0.001$, for the worst, respectively). Furthermore, with both eyes opened, an overlay of the remaining visual fields in glaucomatous patients could be compensated so that it does not worsen the fear of falling.

The fear of falling was also similar among control and ARMD groups despite the worst VA and MD values in the latter group. We also found no significant difference on fear of falling scores between POAG and ARMD groups (24.6 ± 8.7 and 25.3 ± 6.3, respectively; $P = 0.894$). Van Landingham et al.[22] found a borderline statistical significance of group differences between ARMD and glaucoma suspect controls with normal vision. In their study, the ARMD group was older (75.9 years as compared to 69.8 in our study) and the median number of comorbid diseases was higher (2 vs. 1 in our study). Although in our study, the control group comprised subjects with no ocular disease, the results between both studies are comparable. As patients with more advanced disease may be underrepresented within the groups, a post hoc analysis comparing patients with MD values worse than −12.0 dB revealed that ARMD patients have greater fear of falling than glaucoma ones (46.2 ± 16.8 and 24.0 ± 7.7, respectively, $P < 0.001$). This could be due to different patterns of visual field loss in each disease: constrictive in POAG and central defect in ARMD, which tends to affect more the quality of life. Moreover, the visual loss among glaucoma patients is slowly progressive; therefore, these patients can become more easily adapted to the visual deficiency as compared to ARMD patients.

Contrast sensitivity is a measure of the amount of lightness or darkness an object has compared with its background. Both ARMD and POAG patients have reduced contrast sensitivity.[23,24] Using data from a nationally representative sample of community-dwelling adults aged 50+ years, Donoghue et al.[25] examined the association between vision, fear of

falling, and fear-related activity restriction, and assessed the effect of vision on the relationship between fear of falling and mobility. The authors concluded that the participants' perceptions of visual function were related to fear of falling and activity restriction, but that was not explained by VA and contrast sensitivity levels.[25] In another cross-sectional study, Wang et al.[26] examined whether patients with ARMD, glaucoma, or Fuchs corneal dystrophy report limiting their activity due to a fear of falling. Between 40% and 50% of patients with eye disease reported some activity limitation compared with only 16% of controls with normal vision. Contrast sensitivity best explained the relationships between the three eye diseases and activity limitation due to a fear of falling.[26] The ARMD group in their study had far less advanced visual field defect as compared to our study (mean MD −2.8 dB in the better eye versus −9.0 dB) and a number of participants had depression, whereas in our study, depressive patients were not included. The possible effects of contrast sensitivity and the fear of falling were not explored in our study.

The fear of falling is related to visual field defect location. Black et al.[10] reported that damage in the inferior hemifield was associated with a higher rate of falls (relative risk [RR]: 1.57; 95% CI: 1.06 to 2.32), as well as falls with injury (RR: 1.80; 95% CI: 1.12 to 2.98). In a cohort of Japanese POAG patients, defects in the inferior peripheral visual field area were significantly related to the development of a fear of falling.[11] In our study, the MD was used to summarize visual field status. The MD is a weighted average decibel deviation from the normative database and, as such, it does not give any information on the location of the perimetric defect. The small sample size and the choice for MD to evaluate automated perimetry precluded any further analysis on the fear of falling and visual field defect location in our study.

This study was conducted in a developing country with a low income and no medical insurance population and it may raise some issues. How could these results actually be implemented in healthcare in such a setting? Some evidence supports the use of physical therapies to improve the fear of falling, for example, balance training, strength and resistance training, and three-dimensional exercises, such as Pilates, yoga, and Tai Chi. Besides, emerging evidence supports the use of psychological therapies, in particular cognitive behavioral therapy.[27] This approach can be used both in patients with compromised visual function and normal vision. Kendrick et al.[28] concluded that exercise interventions in community dwelling elders probably reduce the fear of falling to some extent immediately after the intervention, without increasing the risk or frequency of falls. These therapies, however, are not accessible to uninsured low income patients and strategies to help this population should be shaped by the local health care administration. Effective health care interventions in the developing world are underutilized, and income-related disparities in use are large. Causes of the problem are many and include insufficient and inappropriate allocation of resources across levels of care; inadequate quality; insufficient household incomes; lack of access to credit; prohibitive formal and informal charges; and misperceptions of illness and the effectiveness of care. Solutions should be aimed to address these causes. The difficulty, however, lies in the design of detailed policy initiatives that tackle root problems within usually severe economic, institutional, and political constraints.[29] On clinical grounds, the recognition of the fear of falling in visually impaired subjects by any physician, impose them the responsibility to advise on how to overcome it. The use of a cane, improving posture, and developing good walking form are simple cost-free strategies that can possibly benefit this specific population since they do not have access to insurance. In Brazil, the third age club is a movement sponsored by local community associations and municipalities whose aims are to provide cultural, social, and sportive activities for elderly over 60 years of age. Some clubs charge an insignificant monthly fee for membership. Some activities such as Pilates, yoga, and dance are available and could benefit patients to reduce the fear of falling at no or very little cost.

Our study has a number of limitations. First, we did not consider whether the patient had previous history of falls. There might have been a memory bias as those who have fallen once or have had recent falls tend to be fearful and more careful in daily activities. Some even start orientation and mobility training after falling, and those were not taken into account either. Second, the ARMD sample was smaller than the other groups; however, our results were statistically significant in the post hoc analysis. Third, we have not stratified glaucoma patients according to visual field defect location; it is believed that patients with inferior visual field defects present with greater fear of falling.[10,11] In fact, the sample size in the latter group was too small to test the difference with adequate statistical power. Fourth, we did not analyze contrast sensitivity with fear of falling. Previous

studies have correlated lower contrast sensitivity and higher fear of falling.[25,26] Fifth, this was a cross-sectional study; therefore, it does not plot possible variables that could be related to increase the fear of falling throughout a patient's life. Last, there might have been an interviewer bias as the questionnaire was read out loud to the patients. We have chosen this approach in that many of the patients from our clinic are wholly or partially illiterate. In addition, the FES-I-Brazil does not weigh the difficulty of the task with the fear of falling; therefore, it is more likely to have item bias—when an item has different difficulty for the two groups and would suggest that items scale differently for them. Further studies could employ the Rasch method in order to avoid this bias.

In summary, the results of this study demonstrated that ARMD patients with compromised visual field do have higher fear of falling as compared to glaucoma and control patients. It is an early finding, which may have implications for future clinical care, but more evidence with larger sample size is needed. Many practitioners might already have their standard practice and this new information may not really change their care. Nevertheless, this observation may assist healthcare providers in their consideration for preventative measures to overcome the fear of falling and falls and to deliver better care to visually handicapped elderly patients who live in a developing country.

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