Original Paper

Association of Visual Impairment and Falls in Elderly Individuals-A Cross-Sectional Study

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ABSTRACT: Background: Falls are considered to be the most frequent and significant cause of unintentional harm and mortality among the elderly. Impaired vision is a significant risk factor for falls. Aim: To analyse the relationship between visual impairment and falls in the elderly. Methodology: This hospital-based cross-sectional study included 270 participants after obtaining informed consent. Details of demographic profile, lifestyle, gait and balance deficits, ophthalmic and systemic condition were collected. The identification of independent risk variables for falls in the elderly was performed by logistic regression analysis. Results: Among 270 participants, 115 participants had falls. The mean age of fallers was 72.97 years. Females had significant falls. 87.8% of participants had visual impairment. Visual risk factors like cataract (80.9%), uncorrected refractive error (59.1%), glaucoma (24.3%), age-related macular degeneration (20.2%), and corneal opacity (13%) were very strongly associated with fall (P<0.001). On multivariate logistic regression analysis visual risk variables like Cataract, uncorrected refractive error and glaucoma had a significant association with falls (P<0.05) with an adjusted odds ratio (aOR) of less than 1. Diabetic retinopathy had strong association of fall (P<0.001) with aOR of 41.8 (95% CI 4.27-409.2). Conclusion: Falls and visual impairment are public health concerns that require attention. Since many causes of visual impairment in the elderly are reversible, lowering the risk of falls in this population may be a controllable goal.

KEYWORDS: *Elderly, Falls, Visual impairment.*

Introduction

Fall is defined as an unintentional descent to the ground or lower level [1].

Falls are considered one of the most frequent principal causes of inadvertent harm and demise in the elderly.

It is evident from studies that many elderly people develop a fear of falls following an episode of a fall, thereby restricting their day-to-day activities [2].

Falls-related mortality is greater in those who are visually impaired and over the age of 50.

Visual impairment may cause a reduced individual's capability to identify hazards thereby leading to a lack of confidence and dependence, decreased social interaction, fear of falling, and increases in risk of falls [3].

Age-related vision changes occur in every older person.

It has been estimated that by 2050, the number of elders among 70-79 years of age, who are visually impaired will increase by 211% and in the elderly more than 80 years who are visually impaired is predicted to increase by 280% [4].

There are varied causes of visual impairment in the elderly.

Presbyopia, cataracts, macular degeneration, diabetic retinopathy, glaucoma, and vision loss from stroke are the prominent visual issues in the elderly.

As people age, they become more likely to develop refractive errors, glaucoma, cataracts, and macular degeneration.

People with visual impairments fall for a variety of internal and external reasons [3].

In developing nations, individuals with impaired vision experience diverse challenges, like inaccessibility, lack of resources and healthcare utility challenges [5].

Hence geriatric people who have visual impairment ought to be the major target of fall risk assessment.

In this study, we examine the associations of visual problems and falls in elderly patients.

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Material and Methods

This hospital-based descriptive study took place at a tertiary care medical college in North Tamilnadu, India, for a year starting in October 2019 after receiving approval from the Institute's ethical board (KIMS/F/2019/23).

A total of 270 participants were recruited from the Department of General Medicine and Ophthalmology after obtaining informed written consent.

Patients with acute diseases, acute painful leg issues, dementia, major depression, and non-participation were excluded from the study.

In-depth questions about the patient's medical history were asked, including any history of falls, arthritis, fractures, visual or hearing impairment, and co-morbidities like diabetes mellitus, hypertension, and coronary artery disease.

Polypharmacy, defined as taking more than five drugs in a month, was recorded in the patient's medical history [6].

The WHO's body mass index (BMI) for the Asian population was computed [7].

The musculoskeletal, neurological, and cardiovascular exams were completed. An ophthalmology examination was done to assess the visual impairment and its etiology.

Visual acuity of <6/12 is considered as an impaired vision [8].

Depending on their history of falls, the study population was divided into two groups: fallers and non-fallers.

The faller group consisted of those who had experienced one or more falls.

Statistical analysis

To analyze the data, SPSS 22.0 was utilized. An expression for a quantitative variable was mean±SD.

Using the Mann-Whitney U test, continuous variables were examined. The category data was presented as a percentage and a number.

The Chi-square test was utilized to ascertain the variation among the categorical data units.

In multivariate logistic regression, all visual risk variables and a variable with a P-value less than 0.25 were incorporated.

It was considered statistically significant if the P-value was less than 0.05.

Results

Baseline characteristics

270 participants grouped as Fallers (N=115) and Non-fallers (N=155) were studied.

A comparison of demographic, lifestyle and general descriptions of fallers and non-fallers were presented in Table 1.

Table 1. Characteristics of the study population.

Parameters	Fallers (≥1 fall) N=115 Frequency (Percentage)	Non-fallers N=155 Frequency (Percentage)	*P* value
Mean Age in years (SD)	72.97 (5.99)	70.73 (4.94)	0.001**
Sex			0.139
Male	45 (39.1)	75 (48.4)	
Female	70 (60.9)	80 (51.6)	
Mean BMI (kg/m^2) (SD)	21.73 (2.18)	22.2 (2.24)	0.085
Hypertension	73 (63.5)	81 (52.3%)	0.082
Diabetes mellitus	56 (48.7)	43 (27.7)	0.001**
Ischemic heart disease	37 (32.2)	29 (18.7)	0.015*
COPD	12 (10.4)	20 (12.9)	0.573
Chronic kidney disease	7 (6.1)	-	0.002*
Tuberculosis	2 (1.7)	-	0.181
Fractures	19 (16.5)	4 (2.6)	<0.001**
Arthritis	72 (62.6)	46 (29.7)	<0.001**
Depression	29 (25.2)	10 (6.5)	<0.001**
Hearing impairment	37 (32.2)	25 (16.1)	0.002*
Incontinence	33 (28.7)	8 (5.2)	<0.001**
Polypharmacy	55 (47.8)	44 (28.4)	0.001*
Postural hypotension	19 (16.5)	5 (3.2)	<0.001**
Mean Hand Grip (kg) (SD)	16.7 (4.63)	17.87 (4.23)	0.033*
Mean TUG (seconds) (SD)	12.41 (4.22)	9.83 (2.71)	<0.001**
Mean POMA (SD)	23.43 (2.94)	25.01 (1.95)	<0.001**
Visual impairment	101 (87.8)	21 (13.5)	<0.001**

BMI-Body mass index, TUG-Timed Up and Go, POMA-Performance-oriented Mobility Assessment, *represents *p*-value ≤0.05, **represents *p*-value≤0.001

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Compared with non-fallers, fallers were more likely to be older, have diabetes, Chronic kidney disease, depression, hearing impairment, incontinence, postural hypotension, and polypharmacy with significant association with falls (p<0.001).

Incidence of falls is more in female participants when compared to males.

Among all the risk factor variables, most of the participants had visual impairment (87.8%) with a very strong association with falls (p<0.001) (Table 1).

The identified causes for visual impairment in this study were cataract, uncorrected refractive error, corneal opacity, age-related macular degeneration, glaucoma and cystoid macular edema (Figure 1).

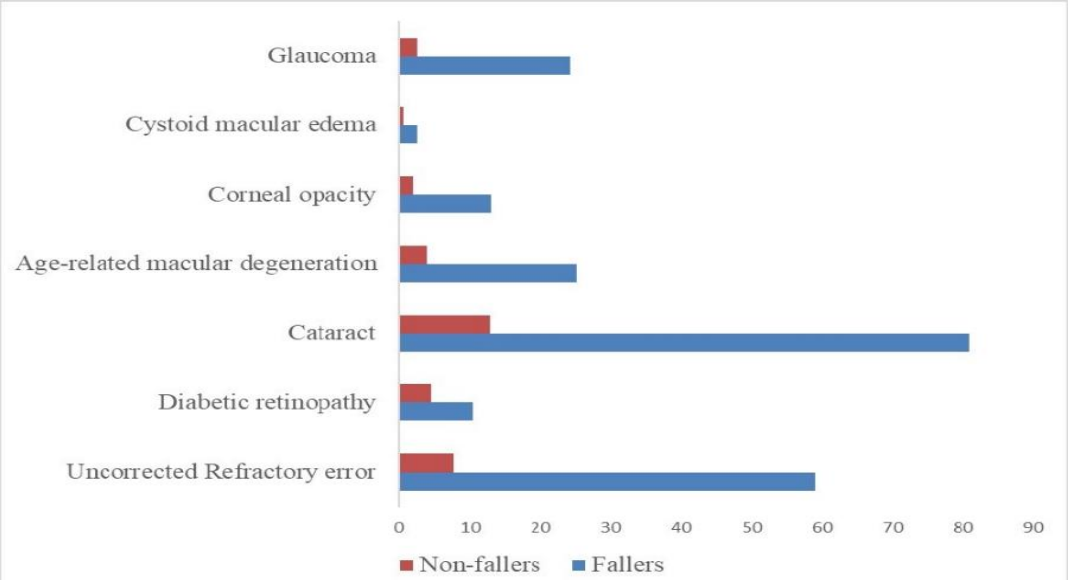

Figure 1. Percentage of visual impairment among study population.

Correctable factors like cataract (80.9%), uncorrected refractive error (59.1%) and corneal opacity (13%) were identified in this study as major causes of visual impairment and were very strongly associated with falls (*P*<0.001).

Other major contributing factors for visual impairment were Age-related macular degeneration (25.2%) and glaucoma (24.3%), which also had a very strong significant association with falls (*p*<0.001).

Diabetic retinopathy (10.4%) and cystoid macular edema (2.6%) were seen more frequently among fallers than non-fallers (Table 2).

Table 2. Visual impairment Vs falls.

Visual impairment	Fallers (≥1 fall) N=115 Frequency (Percentage)	Non-fallers N=155 Frequency (Percentage)	*P* value
Uncorrected Refractory error	68 (59.1)	12 (7.7)	<0.001**
Diabetic retinopathy	12 (10.4)	7 (4.5)	0.090
Cataract	93 (80.9)	20 (12.9)	<0.001**
Age-related macular degeneration	29 (25.2)	6 (3.9)	<0.001**
Corneal opacity	15 (13)	3 (1.9)	<0.001**
Cystoid macular edema	3 (2.6)	1 (0.6)	0.315
Glaucoma	28 (24.3)	4 (2.6)	<0.001**

*represents *p*-value ≤0.05, ** represents *p*-value≤0.001

Multivariable logistic regression analysis showed non-visual risk factors such as diabetes mellitus, arthritis, and incontinence had lower odds of fall (OR<1); but with strong association with fall (*p*<0.01).

Visual risk factors like cataract, uncorrected refractive error and glaucoma had a significant association with falls (*p*<0.05) with an adjusted odds ratio (aOR) less than 1.

Diabetic retinopathy had strong association of fall (*p*<0.001) with aOR of 41.8 (95% CI 4.27-409.2) (Table 3).

Table 3. Multivariable logistic regression of risk factors for falls.

Parameter	adjusted Odds ratio (95% CI)	*P* value
Diabetes mellitus	0.18 (0.05-0.61)	0.007*
Arthritis	0.19 (0.06-0.63)	0.006*
Incontinence	0.09 (0.02-0.43)	0.003*
Uncorrected Refractory error	0.13 (0.03-0.54)	0.005*
Diabetic retinopathy	41.8 (4.27-409.2)	0.001*
Cataract	0.05 (0.01-0.17)	<0.001**
Glaucoma	0.08 (0.007-0.89)	0.040*

*represents *p*-value ≤0.05, **represents *p*-value≤0.001

Discussion

In this study, 87.8% (n=101) of the elderly with more than one fall had visual impairment. This finding correlated with the data reported in the Longitudinal Ageing Study in India (2017-2018) from India [9].

Several studies in the literature have documented visual impairment as an important risk for falls among the elderly.

In a multi-ethnic Asian population-based study among 40 years and above adults and SEED study, visual impairment was found to be significantly associated with falls and recurrent falls with greater risk among female gender [10,11].

In a qualitative study conducted by Brundle C et al. many participants have reported how their visual impairment affected their movement in both indoors and outdoors and resulted in tripping and falls [12].

This study identified cataract, uncorrected refractive error, age-related macular degeneration, glaucoma, diabetic retinopathy, cystoid macular edema and corneal opacity as which are reversible and preventable causes of visual impairment.

Previous studies had also reported similar causes of visual impairment among fallers [13,14].

Tsang JY study cohort also documented a higher rate of falls among the participants with cataract, Age-Related Macular Degeneration, or Glaucoma than people without eye diseases [15].

Cataract

Cataract was the major cause of visual impairment in this study identified in 80.9% (n=93) of the elderly population who had more than one fall.

In spite of several public health interventions cataract remains the major contributing factor for visual impairment [16].

A study done by Shetti S et al. stated that agriculture is the major occupation in rural India and around 66.4% of patients with cataracts were still able to do their everyday tasks [17].

Besides agriculture other income source for the rural population is from daily wage employment.

As a result, an inability to forfeit daily pay and embracing diminishing vision as an expected consequence of aging also contribute to the delayed diagnosis of cataract.

An analysis among adults with cataract revealed that 30.7% of participants had fallen during the Waiting period for cataract surgery [18].

A study on the outcome of cataract surgery in the frequency of falls in older adults reported that surgery in one eye reduced the risk of falls [19].

This study also compliments the significant association of visual impairment, cataract and falls in the elderly with aOR of 0.05(95% CI 0.01-0.17)

Uncorrected refractive error

The prevalence of uncorrected refractive error among the fallers in this study was 59.1%.

Age-related structural changes in the lens and ocular pathologies may contribute to refractive errors in the elderly.

The proportion of uncorrected refractive error is higher in this study whereas previous reports in the literature showed from 40-53%.

A community-based study from North India by Malhotra S et al. and a home-based study from South India by Marmamula S et al. documented visual impairment due to uncorrected refractive error as the major risk factor of falls.

In this study, uncorrected refractive error was identified as a second major cause next to cataract associated with falls in visual impairment [20,21].

High prevalence of refractive errors, poor economic status in rural areas and cost of spectacles may be contributing factors in our study.

Glaucoma

The second most common cause of visual disability worldwide is glaucoma. Asymptomatic

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silent, irreversible, progression of optic neuropathy in glaucoma resulting in delayed diagnosis can be the cause of visual impairment.

Lack of awareness about glaucoma has been identified as one of the important factors preventing patients from accessing comprehensive eye care.

In this study, glaucoma had a very strong significant association with falls in participants with visual impairment.

This finding also correlates with Bhorade AM et al. and O'Connell C et al surveys [21,23].

Age-related macular degeneration

Age-related macular degeneration showed a very significant association with falls in this study; but, multivariable logistic regression analysis did not show the association with fall.

This may be because most patients with exudative age-related macular degeneration are relatively physically inactive due to poor vision and may reduce their exposure to falls.

This is in contrast to the report by Shuyi O et al. and Tsang et al. who revealed a significant association of age-related macular degeneration with falls [13,15].

Diabetic retinopathy

Studies with a strong association between falls and diabetes have identified retinopathy, neuropathy and hypoglycemia as risk factors for falls.

Although Gupta P et al. documented 2 2-fold increased risk of fall in patients with mild to moderate diabetic retinopathy; it was not identified as an independent risk for falls [24,25].

In our study, diabetic retinopathy was significantly associated to fall with aOR of 41.8 (95% CI 4.27-409.2). We need long-term studies to identify diabetic retinopathy as an individual risk factor for falls in the elderly.

Corneal opacity and cystoid macular edema

In the National Blindness and Visual Impairment Survey India 2015-2019 Report, those 50 years of age and older identified corneal opacity as the second most common cause of impaired vision [16].

In our study, 13% of the fallers had corneal opacity and it also had a very significant association with visual impairment and falls.

This study also reported cystoid macular edema (2.6%) as one of the causes of visual impairment, but no association was identified with a fall on multivariable logistic regression.

However, none of the previous studies also reported corneal opacity and cystoid macular edema as a cause of visual impairment in the elderly with falls.

Limitations: This single-centered study typically focuses on a specific location or population, which can limit the diversity of participants and contexts. This narrow scope often results in restricted external validity, meaning the findings may not be generalizable to broader populations.

Conclusion

Falls and impaired vision are public health concerns that require addressing. We identified a distinct link between impaired vision and falls. Many causes of visual impairment are often preventable and thus a modifiable factor for reducing fall risks. Hence aggressive vision screening and intervention strategies are needed to add on falls rehabilitation programs to reduce the fall risks.

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All authors have read and approved the final manuscript.

Author Contributions

Conceptualization, J.G., S.G, and S.V.; Methodology, J.G., S.G., S.V, and A.G.; Data curation, J.G., S.G., S.V. and MRHMK.; Validation, J.G., MRHMK, and A.G.; Data analysis, S.V, and A.G.; Manuscript Writing and initial original draft preparation: J.G., S.G, and MRHMK; Manuscript review and editing, S.V. and A.G.

All authors read and approved the final manuscript.

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Conflicts of interest

The authors declare no competing interests.

Institutional Review Board

The study was conducted according to the guidelines of the Declaration of Helsinki; the study and the protocols utilised therein were approved by the Institutional Review Board (Ethics Comitee-Human studies) of Karpaga Vinayaga Institute of Medical Sciences and Research Centre, (KIMS/F/2019/23).

Consent Statement

All human subjects involved in this study provided a written informed consent prior to participation, including the consent of publishing their anonymized data.

Data availability

All data presented in the manuscript are available from the corresponding author upon request.

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