JAMDA 24 (2023) 105–112

JAMDA

journal homepage: www.jamda.com

Original Study

Risk Factors for Vision Loss among Nursing Home Residents: A Cross-Sectional Analysis

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Keywords:
Vision impairment
vision care
nursing homes
public health
older adults

A B S T R A C T

Objective: Approximately 2% of older adults currently live in nursing homes. It is important that the risks for vision loss be characterized to ensure appropriate vision care is provided for nursing home patients. Our objective was to evaluate the association of age-related eye diseases (AREDs) and multimorbidities with vision loss.
Design: Cross-sectional study.
Setting and Participants: This is a cross-sectional analysis of comprehensive eye examination records for 7753 residents of 74 North Carolina nursing homes who were ≥65 years of age at time of the initial patient visit.
Methods: Complete data on vision and associated factors were included from the standardized Centers for Medicare and Medicaid Services eye examination. We defined vision impairment and blindness respectively as best-corrected visual acuity between 20/40 and 20/200, and 20/200 or worse. Clinical diagnoses of AREDs were defined by the attending clinician. Data were extracted from electronic health records, and all analyses were conducted in SAS v 9.4. We used descriptive statistics to summarize the resident characteristics and AREDs and logistic regression analysis to examine independent risk factors for vision impairment.
Results: A total of 7753 initial eye examination records with complete data were included in the analysis. Overall, 34% of the residents had normal vision, 43% had vision impairment, and 23% were blind. Among participants with various AREDs, the prevalence of vision impaired/blind ranged from 63% to 76%, while blindness ranged from 23% to 53%. We found correction of refractive error alone served to reduce vision impairment or blindness.
Conclusions and Implications: Comprehensive eye examinations showed vision impairment and blindness affected 66% of nursing home residents, overall. This study substantiates the positive impact of comprehensive eye examinations to promote visual, systemic, and cognitive health and well-being and the need that eye care service be used to inform policy and practice to improve patient functioning and independence.

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In 2020, 596 million people worldwide suffered vision impairment and 43 million were blind. Further, it was proposed that more than 90% of the vision impairment might have been prevented or treated through means of current interventions.[1] Refractive or organic vision loss affects people of all ages; however, older institutionalized people are particularly vulnerable. Although only 2% (1.4 million) of all adults ≥65 years old in the United States reside in nursing homes,[2] the impact of untreated eye care on vision loss has been clearly demonstrated from a representative sample of Delaware nursing home residents.[3] The nursing home residents showed a high prevalence of vision loss of 63.4% including vision impairment in 49.3% of residents and blindness in 14.1%. Other studies have provided supporting evidence that the residents most vulnerable to vision loss are women, racial/ethnic minorities, those from lower income levels, and the less

The authors declare no conflicts of interest.

Partial results were presented in a poster at the Association of Research in Vision and Ophthalmology meeting — May 4, 2022, Denver, CO, USA.

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https://doi.org/10.1016/j.jamda.2022.10.018
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educated.[4] Institutionalized populations have also been found more likely to experience a higher risk of dementia development,[5] comorbidities,[6] and falls,[7] suffer health conditions that result in a higher prevalence of depression and mortality,[8] and poorer quality of life.[9]

In less than 30 years, the population growth of people ≥65 years old will nearly double from 2012 levels. This growth will lead to an estimated 33% increase in persons visually impaired and estimated 30% increase in blindness.[1] Increased prevalence of vision loss in the general population will carry over into institutionalized patient populations. Action that is directed at prioritizing eye health is keenly needed now in our nursing home communities where the prevalence of age-related eye diseases (AREDs), refractive conditions (particularly presbyopia), and noncommunicable systemic diseases that result in vision loss is already inordinately high.

Since 1957, there have only been a handful of prior nursing home studies that attempted to identify and explain the prevalence of age-related eye disease or vision loss among nursing home residents and this area of research remains understudied.[3] In 2021 the eye health status of nursing home residents was clinically quantified, using the largest sample of nursing home residents ever collected. The study successfully linked prevalence of AREDs and vision loss.[3] Although prior nursing home studies have demonstrated that residents are highly vulnerable to vision loss and blindness,[10–13] measures of vision impairment and eye diseases generally failed to provide sufficient or consistent data needed to influence decisions that would implement eye care programs that could improve patient independence and quality of life.

Numerous national efforts have highlighted the importance of eye care in nursing homes. In 1992 and 1997, the American Public Health Association introduced resolutions proposing that eye care be mandated in nursing homes. Again, in 2016, the National Academies of Sciences, Engineering, and Medicine (NASEM) report *Making Eye Health a Population Health Imperative: Vision for Tomorrow*, stressed "Avoidable vision impairment occurs too frequently in the United States and is the logical result of a series of outdated assumptions, missed opportunities, and manifold shortfalls in public health policy and health care delivery".[14]

National efforts continue to stress the key imperatives of the NASEM report. There have been 3 key responses stressing the importance of surveillance research which describe vision over lifespan within defined populations. In February 2018, Prevent Blindness, in cooperation with the National Association of Chronic Disease Directors, created a backbone organization, the Center for Vision and Population Health, to translate and put into action the NASEM recommendations.[15] That same year the American Geriatrics Society and National Institute on Aging sponsored the Bench-to-Bedside Conference: Sensory Impairment and Cognitive Decline in Older Adults.[16] Most recently, The Lancet Global Health Commission has proposed the need to achieve health equity for those individuals who are suffering vision loss.[10] The recommendations from these 3 groups highlight the fact that data from institutionalized patient settings is lacking.

The Lancet Global Health Commission also proposed that the framework for vision loss should be within the context of a human rights approach to healthy aging, emphasizing that proper eye care should overcome social, structural, and legal barriers.[1] Policy has not been implemented and the issue of eye care delivery in nursing homes has historically been hampered by these barriers and to this day is not mandated, despite the resolutions introduced 30 years ago. However, if implemented, there is evidence that vision problems are amenable to refractive or therapeutic correction with resultant substantial improvement in quality of life and functioning of people living in nursing homes.[17]

Detection and treatment of age-related eye diseases and appropriate refractive corrections represent essential first steps in identifying key factors potentially linking vision loss with health and well-being and are critical to care planning and resident centered care.[18–20]

The purpose of this study is 2 fold as our clinical data provide an opportunity to identify vision factors contributing to vision loss: factors that improve safety and mobility in the nursing home environment and facilitate staff communication, awareness, and participation. First, using a larger cohort population of North Carolina nursing home residents, we will validate the vision and eye health status and generalizability of clinical data reported from Delaware nursing homes.[3] Second, we will propose a means to create a unique institutional surveillance database, using comprehensive clinical data typically recorded in a comprehensive eye examination and target factors in the development of vision impairment and blindness.

Deriving more clinically detailed knowledge of visual function and eye health should facilitate the implementation of focused interventions leading to measurable improvements in visual function, and quality of life. Further validation and expansion of nursing home data will provide a reliable means to inform these key issues.

Methods

Data Set and Study Sites

The Western North Carolina Nursing Home study (WNCNHS) is a cross-sectional, study. All clinical data were collected from residents in North Carolina nursing facilities from 2010–2018. The WNCNHS is comprised of 74 certified Medicare and Medicaid nursing homes representing 19% of the total number of facilities in the state. Of the 74 facilities, 73 facilities were for profit and 1 was nonprofit (government owned). The participating facilities represented approximately 6600 total beds. The facility size ranged from 40 to 150 beds (median = 90).

Figure 1 shows the STROBE flowchart. A total of 9821 deidentified encounters were extracted from electronic medical records.[21] We excluded 11 records, which we verified as duplicates, 930 records verified as follow-up visits, and a further 1127 records which did not have data for incoming visual acuity. For the purpose of this study, we applied the following inclusion criteria: (1) initial clinical examination records, (2) residents age 65 years+, and (3) measured incoming visual acuity. As a result, 7753 records with complete data for our

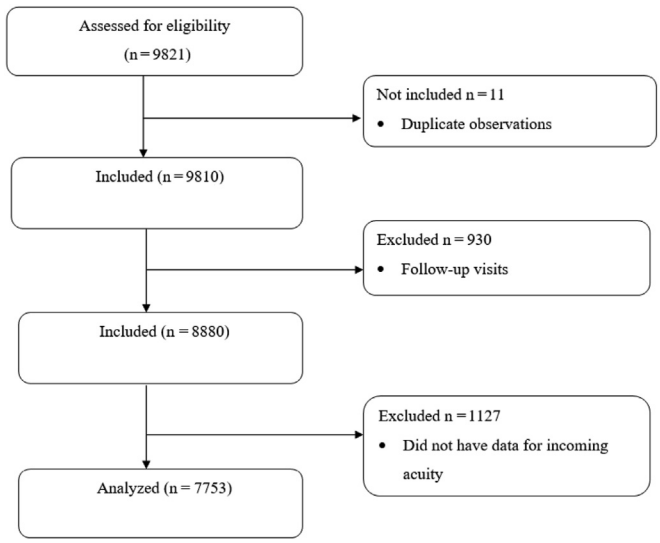

Fig. 1. STROBE flowchart from the WNCNHS for inclusion in the analysis population.

variables of interest were included in the analyses. Content and structure of the comprehensive eye examination is described elsewhere.[3]

The Institutional Review Board (IRB) of University of South Florida determined that this study did not constitute research involving human subjects as defined by Department of Health and Human Services and Food and Drug Administration regulations and therefore was exempt from IRB review.

Study Population Participation

All the resident families were personally contacted by a nursing home staff member and given the opportunity to have the resident's eyes examined. The families or patients could make a personal request to the attending physician that the examination be performed, and the medical director or attending physicians at each facility could also initiate a referral based on a clinical concern. All patients required a doctor's order before the examination could be performed.

Examination

All vision examinations were conducted by a single optometrist who specializes in nursing home eye care. Each patient received a standardized examination, in conformance with the Centers for Medicare and Medicaid Services guidelines. The examination included a detailed medical and ocular history, refraction, tonometry, biomicroscopy, and dilated fundoscopy.[21] All examinations were performed in the resident's room or a designated examination area within the facility. Patients were seen bedside when bedbound.

Every patient had their pupils dilated and internal examinations were performed using a direct ophthalmoscope and indirect ophthalmoscope with a 20-diopter condensing lens. Box presents descriptions of the clinical tests, specifically pertaining to vision, performed during these examinations.

Study Variables

Data that were not specifically assessed during the patient examination were extracted from electronic medical records and assumed present if the condition was documented as diagnosed or treated. All variables relevant to the objective of this study were programmatically extracted by an IT specialist. Each variable abstracted was defined, scaled, and manually reviewed for consistency and accuracy. Where irregular or missing values were identified, records were manually reviewed.

Box. Tests Performed during Clinical Examination

Domain	Method of assessment/definition
Presenting visual acuity	Measured using a portable Burnell BC/1264 wall chart that was calibrated for a 10-foot testing distance. Letters were black on a white background. Presenting visual acuity was recorded with the patient's habitual prescription, if available.
Corrected visual acuity	Manifest acuity was recorded if the prescription improved acuity and glasses were prescribed.
Vision impairment	Acuity 20/40 but better than 20/200
Blindness	Acuity 20/200 or worse and determined by best corrected acuity in either eye
Intraocular pressure	Measured using a Reichert Tono-Pen AVIA Tonometer.
Refractive error	Measured using the Nidek Autorefractor.

Key Variables Selection Criteria

We used the presenting visual acuity to define the vision status of the patient. Manifest acuity was used to compare with presenting acuity in the determination of vision improvement solely on the basis of refractive error. Vision impairment and blindness were defined by US criteria,[22] where vision impairment is defined as best corrected acuity between 20/40 but better than <20/200 and blindness as 20/200 or worse. Age-related eye health variables were defined using clinically established criteria[23]: cataract was defined as trace to +4 for any type of cataract, cataract treatment was included; glaucoma was defined as cupping greater than 0.6 and/or intraocular pressure >21, or patient was prescribed glaucoma medication; macular degeneration required explicit documentation in the record and was classified according to "wet" or "dry" based on the description; diabetic retinopathy was classified as non-proliferative or proliferative when documented by diagnosis; and systemic diabetes was recorded "present" when it was documented in the patient's medical record, or there was evidence of the patient taking diabetic medication.

Statistical Analyses

For this descriptive analysis of cross-sectional medical records data, we generated summary statistics for variables based on the type of variable (ie, mean and standard deviation for continuous; proportions for binary and categorical) and by vision status (ie, normal, visual impairment, blind). To facilitate interpretation, visual impairment and blindness were combined into a single binary variable: vision loss in the multivariable regression analysis. We tested for differences in vision status within variables using χ^2 for categorical variables. In addition, we performed both unadjusted and adjusted logistic regressions to explore the associations between resident characteristics and (1) vision loss or blindness and (2) blindness alone. The adjusted model included all variables, irrespective of their unadjusted significance. For our descriptive statistics and regressions for vision impairment and blindness, all variables had complete data, thus, we did not perform any imputation for missing variables. We analyzed the data using SAS v 9.4, and a P value of <.05 was considered statistically significant.

Summary statistics were used to show the acuity improvement provided solely from spectacle correction. These data were derived from the data set of 7753 patients, restricted to those who had a measure for both incoming and manifest acuity. The column of presenting acuities was stratified into categories of normal, visually impaired, and blind. SAS was used to sequence the variables into frequencies by these categories, then a comparison was made using the manifest acuity column. Acuity improvement solely on the basis of refractive improvement was established by a category improvement (eg, vision impaired to normal, and blind to visually impaired or normal).

Results

Study Sample

Table 1 summarizes patient demographic and clinical characteristics overall and stratified by vision status. Patients had a mean age of 82.6 years (standard deviation = 8.5) and the majority were female (67.9%) and White (75.5%). Prevalence of AREDs in this population was 51.1% for untreated cataract, 26.9% for macular degeneration, 16.5% for glaucoma, and 3.3% for diabetic retinopathy. In addition, 40.6% of the

Table 1
Individual Characteristics of the Study Population Overall and Stratified by Vision Status (n = 7753)

	Total (n = 7753)	1 (Normal) (n = 2612)	2 Visual Impairment (n = 3371)	3 (Blind) (n = 1770)	*P* Value
Age, y, mean (SD)	82.6 (8.5)	81.4 (8.3)	82.8 (8.4)	84.0 (8.7)	<.001
Sex, n (%)					.002
Male	2486 (32.1%)	872 (33.4%)	1106 (32.8%)	508 (28.7%)	
Female	5267 (67.9%)	1740 (66.6%)	2265 (67.2%)	1262 (71.3%)	
Race/ethnicity, n (%)					<.001
White	5852 (75.5%)	2028 (77.6%)	2575 (76.4%)	1249 (70.6%)	
Black/African American	541 (7.0%)	178 (6.8%)	232 (6.9%)	131 (7.4%)	
Hispanic or Latino	23 (0.3%)	6 (0.2%)	10 (0.3%)	7 (0.4%)	
Other	20 (0.3%)	10 (0.4%)	7 (0.2%)	3 (0.2%)	
Missing	1317 (17.0%)	390 (14.9%)	547 (16.2%)	380 (21.5%)	
Cataract, n (%)					<.001
No	187 (2.4%)	22 (0.8%)	56 (1.7%)	109 (6.2%)	
Fully corrected	2851 (36.8%)	1182 (45.3%)	1116 (33.1%)	553 (31.2%)	
Partially corrected	752 (9.7%)	235 (9.0%)	328 (9.7%)	189 (10.7%)	
Uncorrected	3963 (51.1%)	1173 (44.9%)	1871 (55.5%)	919 (51.9%)	
Macular degeneration, n (%)					<.001
No	5667 (73.1%)	2116 (81.0%)	2429 (72.1%)	1122 (63.4%)	
Yes	2086 (26.9%)	496 (19.0%)	942 (27.9%)	648 (36.6%)	
Glaucoma, n (%)					<.001
No	6473 (83.5%)	2221 (85.0%)	2835 (84.1%)	1417 (80.1%)	
Yes	1280 (16.5%)	391 (15.0%)	536 (15.9%)	353 (19.9%)	
Diabetic retinopathy, n (%)					.59
No	7498 (96.7%)	2519 (96.4%)	3267 (96.9%)	1712 (96.7%)	
Yes	255 (3.3%)	93 (3.6%)	104 (3.1%)	58 (3.3%)	
Systemic diabetes, n (%)					<.001
No	4605 (59.4%)	1441 (55.2%)	1987 (58.9%)	1177 (66.5%)	
Yes	3148 (40.6%)	1171 (44.8%)	1384 (41.1%)	593 (33.5%)	

study sample had systemic diabetes. The proportion of patients with normal vision was 33.7% (n = 2612), impaired vision was 43.5% (n = 3371), and blindness was 22.8% (n = 1770). Compared with people reporting normal vision, patients with impaired vision or blindness were on average older, more likely to be female, and have at least one ARED or systemic diabetes. Figure 2 presents the distribution of vision status across patient demographic characteristics.

The prevalence of patients who were vision impaired/blind as well as prevalence of only blind patients can be derived from Table 1. Overall prevalence of vision impaired/blind was 66.3% (5141 of 7753)

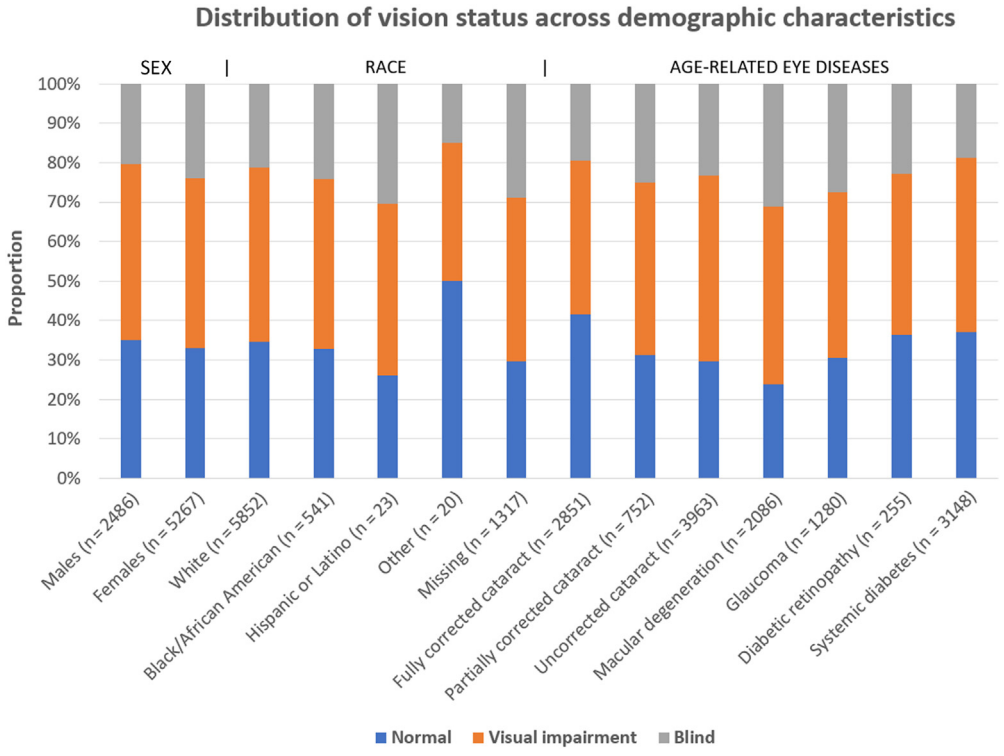

Fig. 2. Distribution of vision status across demographic characteristics.

Table 2
Unadjusted and Adjusted Associations With Vision Impairment or Blindness

	Unadjusted		Adjusted*	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Age group				
65–74	Reference		Reference	
75–84	1.18 (1.03–1.34)	.014	1.24 (1.08–1.41)	.002
85–94	1.42 (1.25–1.62)	<.001	1.42 (1.23–1.64)	<.001
95+	2.41 (1.91–3.04)	<.001	2.21 (1.73–2.84)	<.001
Sex				
Male	Reference		Reference	
Female	1.10 (0.99–1.21)	.076	1.03 (0.93–1.14)	.61
Race/ethnicity				
White	Reference		Reference	
Black/African American	1.08 (0.90–1.30)	.412	1.20 (0.99–1.46)	.06
Hispanic or Latino	1.50 (0.59–3.82)	.392	1.57 (0.61–4.05)	.35
Other	0.53 (0.22–1.28)	.157	0.66 (0.27–1.61)	.36
Missing	1.26 (1.11–1.44)	<.001	1.34 (1.17–1.53)	<.001
Cataract				
Fully corrected	Reference		Reference	
Partially corrected	1.44 (1.22–1.71)	<.001	1.50 (1.26–1.79)	<.001
Uncorrected	1.56 (1.41–1.73)	<.001	1.88 (1.69–2.09)	<.001
Macular degeneration				
No	Reference		Reference	
Yes	1.91 (1.70–2.14)	<.001	1.86 (1.65–2.10)	<.001
Glaucoma				
No	Reference		Reference	
Yes	1.19 (1.04–1.35)	.009	1.14 (0.99–1.30)	.06
Diabetic retinopathy				
No	Reference		Reference	
Yes	0.88 (0.68–1.14)	.34	1.23 (0.93–1.61)	.14
Systemic diabetes				
No	Reference		Reference	
Yes	0.77 (0.70–0.85)	<.001	0.84 (0.76–0.93)	<.001

*All were variables included in adjusted model, irrespective of univariable significance.

and was above 60% for each age, sex, and race category. Prevalence of vision impaired/blind was 70.4% (2790 of 3963) for untreated cataracts, 76.2% (1590 of 2086) with macular degeneration, 69.5% (889 of 1280) with glaucoma, and 63.5% (162 of 225) with diabetic retinopathy and 62.8% (1977 of 3148) for systemic diabetes. Among patients with AREDs, prevalence of blindness ranged from 22.8% (58 of 225) for patients with diabetic retinopathy to 31.1% (648 of 2086) for patients with macular degeneration.

Table 2 presents association estimates for vision impaired/blind with age, sex, race/ethnicity, AREDs, and systemic diabetics. In unadjusted analyses, odds of vision impaired/blindness were significantly ($P < .05$) higher among patients 95 years and older compared with patients 65–74 years old [odds ratio (OR) = 2.41 (95% CI = 1.91–3.04)] and was higher among female compared with male patients [OR = 1.10 (0.99–1.21)]. The odds were also significantly higher among patients with missing race, uncorrected cataract, macular degeneration, and glaucoma. Adjusting for all variables, significantly increased odds of vision impairment or blindness were observed for patients with uncorrected cataract [OR = 1.88 (1.69–2.09)], and macular degeneration [OR = 1.86 (1.65–2.10)]. We found the odds of vision impairment and blindness were decreased among patients with systemic diabetes [OR = 0.84 (0.76–0.93)]. Neither diabetic retinopathy, nor glaucoma was significant in the adjusted analysis.

Table 3 presents the unadjusted and adjusted association estimates for blindness alone. In the adjusted model, the odds of blindness were statistically significantly higher among patients with macular degeneration by 1.8 times [OR = 1.75 (1.55–1.98)], 1.3 times higher for glaucoma [OR = 1.31 (1.14–1.50)], and 1.2 times higher for uncorrected cataracts [OR = 1.24 (1.10–1.40)]. As with vision impairment or blindness, systemic diabetes was significantly associated with a decrease in blindness alone [OR = 0.71 (0.63 −0.80)]. Supplementary Table 1 provides the unadjusted and adjusted analysis for the associations between these characteristics and vision impairment alone.

Acuity Improvement Solely on the Basis of Refractive Correction

Of the 7753 records that we included in our sample with incoming measures for visual acuity, 1681 (21.7%) had a manifest acuity assessed after refractive correction. Table 4 restricts the sample to these residents and shows the changes in vision status that are achievable with simple refractive correction across the 3 categories of incoming acuity (ie, normal, visual impairment, and blind). Of those who were visually impaired, 36.7% (373 of 1016) could be corrected to normal vision, and of those who were blind at initial assessment, 75% (106 of 141) and 5% (7 of 141), respectively, could be improved to vision impaired or normal vision (Figure 3).

Discussion

This study of 7753 nursing home residents, age ≥65 years in western North Carolina provides the opportunity to affirm and extend the findings of the Delaware Nursing Home Eye Study (DNHES). In general, we found AREDs and vision impairment were highly prevalent among nursing home residents and that these had similar prevalence in both samples. As in the DNHES, we found that patients who were older, women, and those with diagnosed eye diseases had more than a 60% prevalence of vision loss. These data, based on clinical assessment, open a means and opportunity to establish a baseline assessment methodology capable of identifying and quantifying vision assessment as a modifiable risk factor that may influence the development and progression of dementia, an incurable age-related disease that affects nearly two-thirds of nursing home residents.[24]

Table 3
Unadjusted and Adjusted Associations With Blindness

	Unadjusted		Adjusted*	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Age group				
65–74	Reference		Reference	
75–84	1.08 (0.92–1.26)	.361	1.02 (0.87–1.20)	.82
85–94	1.29 (1.11–1.51)	<.001	1.06 (0.90–1.26)	.47
95+	2.30 (1.85–2.86)	<.001	1.65 (1.30–2.08)	<.001
Sex				
Male	Reference		Reference	
Female	1.23 (1.09–1.38)	<.001	1.13 (1.01–1.28)	.04
Race/ethnicity				
White	Reference		Reference	
Black/African American	1.18 (0.96–1.45)	.121	1.37 (1.11–1.70)	.004
Hispanic or Latino	1.61 (0.66–3.93)	.293	1.65 (0.67–4.08)	.28
Other	0.65 (0.19–2.23)	.494	0.87 (0.25–2.99)	.83
Missing	1.50 (1.31–1.71)	<.001	1.59 (1.38–1.82)	<.001
Cataract				
Fully corrected	Reference		Reference	
Partially corrected	1.21 (1.00–1.45)	.049	1.24 (1.03–1.50)	.03
Uncorrected	1.08 (0.97–1.21)	.165	1.24 (1.10–1.40)	<.001
Macular degeneration				
No	Reference		Reference	
Yes	1.83 (1.63–2.05)	<.001	1.75 (1.55–1.98)	<.001
Glaucoma				
No	Reference		Reference	
Yes	1.36 (1.19–1.56)	<.001	1.31 (1.14–1.50)	<.001
Diabetic retinopathy				
No	Reference		Reference	
Yes	0.99 (0.74–1.34)	.974	1.36 (0.99–1.86)	.06
Systemic diabetes				
No	Reference		Reference	
Yes	0.68 (0.61–0.76)	<.001	0.71 (0.63–0.80)	<.001

*All were variables included in adjusted model, irrespective of univariable significance.

Vision loss because of organic or refractive limitations may also contribute to physical inactivity and social isolation which are associated with falls and depressive symptoms. Eighty percent of vision loss can be managed and treated.[25] The resultant impact of eye care intervention has never been reported, but there is clear evidence that further exploration of these factors in our current database will allow us to explore this question in more detail. This clinical dataset will also allow us to explore the combined impact of hearing and vision loss suffered by many residents where dementia risk may be significantly higher.[26–28]

Systemic disease has common metabolic and vascular pathways and the resultant systemic breakdown is visible as damage to the retina and its microvasculature. In both DNHES and WNCNHS studies, diabetes and diabetic retinopathy were identified as risk factors for vision loss and were singled out for their potential as biomarkers for cerebrovascular change associated with stroke and progression of dementia.[29] However, we also found some differences in the associations, namely systemic diabetes which was found to have a protective effect in both adjusted and unadjusted analyses. There are several factors that may contribute to this variability in the findings between the two facilities. Both studies relied on physician referrals for eye care and this might introduce variability because of differences in referral criteria from each facility. For diagnosis of systemic diabetes, the optometrist relied on documentation of diagnosis in the patient record, or the evidence of a diabetic drug prescribed for the patient. Transfer of those data may have led to transcription errors or variability in the method the data were collected. Patient examination by an eye care specialist is likely to identify more pathology than review of potentially fragmented patient records. The age and racial/ethnic composition of nursing home residents may also account for some variation in eye diseases.

The clinical data collected in WNCNHS comprise a more robust data set for eye disease and visual function than the DNHES as an additional assessment of refractive correction was made. The assessment of best corrected acuity allows us to derive the potential for a treatment effect of spectacle correction alone on vision impairment and blindness (Table 4). These data have been collected in a systematic way across institutions and can be used to inform policy and practice. This study substantiates the potential use of the data available from a comprehensive vision examination and allows

Table 4
Prevalence of Improved Vision from Blind and Vision Impairment (n = 1681)

Incoming Acuity	n	Manifest_Rx		
		Normal	Visual Impairment	Blind
		Prevalence (Cases)	Prevalence (Cases)	Prevalence (Cases)
Normal (n = 2612)	524	20.1% (524)	0% (0)	0% (0)
Visual impairment (n=3371)	1016	11.1% (373)	18.9% (643)	0% (0)
Blind (n = 1770)	141	0.4% (7)	5.9% (106)	1.6% (28)

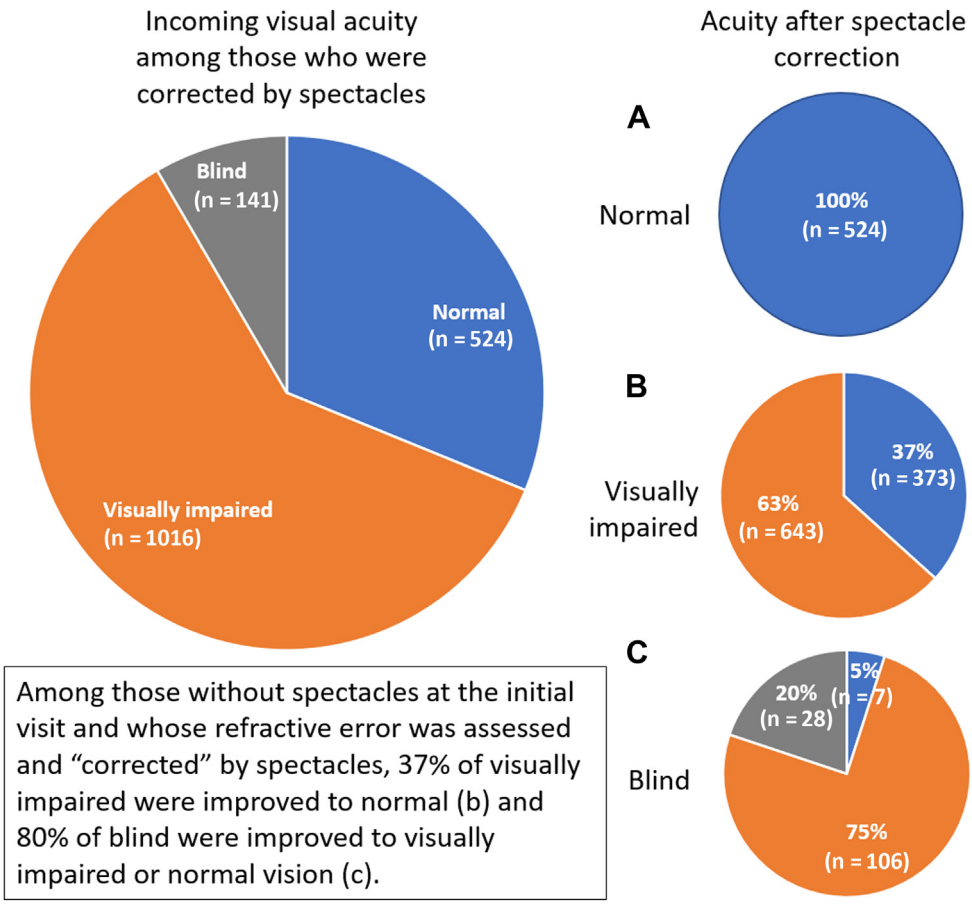

Fig. 3. Change in vision status after spectacle correction.

investigators, for the first time, to distinguish the role of treatment of organic disease and that solely possible by optical means. The cost-benefit solely derived from dispensing spectacle lenses to correct refractive error are evident in daily clinical practice. In cases of profound dementia, the lead author has evidenced on many occasions, while dispensing spectacles, that the resident responded to vision improvement by returning to social engagement and interaction with family and staff members. Future prospective studies can measure quality of life by incorporating quantifying measures and can more formally evaluate the potential cost-benefit relationship of simple spectacle correction.

In addition, given the depth of the clinical examinations performed among the residents, there are many remaining questions about older and institutionalized adults that may yet be answered using the data from the WNCNHS. Although measures of hearing loss, cognitive impairment, and quality of life are present, our overarching goal in this study was to assess the generalizability of the sample by assessing vision outcomes and comparing our findings to those from the DNHES study.

Strengths and Limitations

The strength of this study is marked by the rigorous and comprehensive nature of the eye examinations by a single eye care provider, and the large study population. The characteristics of the residents of the North Carolina facilities mimic those in Delaware and further substantiates their representative nature nationwide.

This study is limited by the nature of retrospective clinical data, which make cleaning of the data for analyses extremely challenging and limits our analyses and inferences to the data provided, under the assumption that the data are complete and accurate.

Conclusion and Implications

These findings clearly demonstrate that vision loss and AREDs are important sources of morbidity among older institutionalized adults and establish the potential benefit of organized eye care services in nursing homes that would provide a means to monitor surveillance data for eye diseases and optical optimization of visual capability in this population. The impact of creating data sets from institutionalized data is clear and far reaching. With these data, we can address specific concerns that have gone unanswered in this population, such as the impact that vision and hearing loss has on frailty, cognitive decline, and quality of life; the role of vision in fall prevention and patient safety; interprofessional and staff education that is tailored to patients with special visual needs; and human factor considerations, like lighting, contrast, and design of facilities to promote safe mobility and navigation for patients. All of these factors may be incorporated into resident-centered care and tailored patient care planning. Future studies will explore these issues.

Acknowledgments

We acknowledge Rebecca Wartman for her contributions to this research and the field by creating the database used in this study from her own practice in North Carolina nursing homes. We also acknowledge Poojitha sai Machavarapu for her efforts in cleaning the data for analysis.

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Supplementary Table 1
Unadjusted and Adjusted Associations With Vision Impairment

	Unadjusted		Adjusted	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Age group				
65–74	Reference		Reference	
75–84	1.11 (0.98–1.26)	.099	1.20 (1.05–1.37)	.006
85–94	1.16 (1.02–1.31)	.02	1.32 (1.15–1.51)	<.001
95+	1.07 (0.88–1.31)	.484	1.26 (1.02–1.56)	.033
Sex				
Male	Reference		Reference	
Female	0.94 (0.86–1.04)	.218	0.94 (0.85–1.04)	.227
Race/ethnicity				
White	Reference		Reference	
Black/African American	0.96 (0.80–1.14)	.616	0.96 (0.80–1.15)	.63
Hispanic or Latino	0.98 (0.43–2.24)	.96	0.99 (0.43–2.28)	.99
Other	0.69 (0.27–1.72)	.421	0.70 (0.28–1.77)	.451
Missing	0.90 (0.80–1.02)	.103	0.91 (0.81–1.03)	.15
Cataract				
Fully corrected	Reference		Reference	
Partially corrected	1.23 (1.05–1.45)	.012	1.24 (1.06–1.46)	.009
Uncorrected	1.42 (1.29–1.57)	<.001	1.50 (1.36–1.66)	<.001
Macular degeneration				
No	Reference		Reference	
Yes	1.10 (0.99–1.22)	.07	1.11 (0.99–1.23)	.07
Glaucoma				
No	Reference		Reference	
Yes	0.93 (0.82–1.04)	.207	0.92 (0.81–1.04)	.178
Diabetic retinopathy				
No	Reference		Reference	
Yes	0.89 (0.69–1.15)	.381	0.97 (0.75–1.27)	.844
Systemic diabetes				
No	Reference		Reference	
Yes	1.03 (0.94–1.13)	.477	1.08 (0.98–1.19)	.118