HHS Public Access

Author manuscript

J Appl Gerontol. Author manuscript; available in PMC 2024 June 01.

Published in final edited form as:

J Appl Gerontol. 2024 June ; 43(6): 755–764. doi:10.1177/07334648241231374.

Vision Impairment and Frailty among Mexican American Older Adults: A Longitudinal Study

Mandi L. Sonnenfeld, PhD, OTR[1], **Monique R. Pappadis, MEd, PhD**[2,6], **Timothy A. Reistetter, PhD, OTR**[3], **Mukaila A. Raji, MD, MS**[4], **Kenneth Ottenbacher, PhD, OTR**[5], **Soham Al Snih, MD, PhD**[2,4,5,6]

[1]Michael E. DeBakey Veterans Affairs Medical Center, Center for Innovations in Quality, Effectiveness and Safety (IQuEST), 2450 Holcombe Blvd, Suite 01Y, Houston, Texas 77021

[2]Department of Population Health and Health Disparities, School of Public and Population Health, University of Texas Medical Branch, 301 University Blvd, Galveston, Texas, 77555

[3]Department of Occupational Therapy, School of Health Professions, UT Health San Antonio, 7703 Floyd Curl Drive, Mail Code 6243 San Antonio, TX 78229-3900

[4]Division of Geriatrics and Palliative Medicine/Department of Internal Medicine, University of Texas Medical Branch, 301 University Blvd, Galveston, Texas, 77555

[5]Department of Nutrition, Metabolism, and Rehabilitation Sciences, School of Health Professions, University of Texas Medical Branch, 301 University Blvd, Galveston, Texas, 77555

[6]Sealy Center on Aging, University of Texas Medical Branch, 301 University Blvd, Galveston, Texas, 77555

Abstract

We examined the relationship between vision impairment (VI) and new-onset frailty among non-frail Mexican American older adults (≥ 70 years) at baseline and determined the differential impact of VI on each frailty criteria. Data were from an 18-year prospective cohort from the Hispanic Established Population for the Epidemiologic Study of the Elderly (1998/1999, N=1072 to 2016, N=175). Frailty was defined as ≥3 criteria: unintentional weight loss of >10 pounds, weakness, exhaustion, low physical activity, and slowness. VI was defined as difficulty in recognizing a friend at arm's length's away, across the room, or across the street. We found that participants with VI (near or distant) and distant VI had greater odds of frailty (near or distant VI, OR=1.89, 95% CI=1.30–2.73 and distant VI, OR=1.95, 95% CI=1.34–2.86, respectively) after controlling for covariates over time. Early screening (optimal management) of VI may prevent or delay onset of frailty among older Mexican Americans.

Mandi.Sonnenfeld@bcm.edu, @SonnenfeldOT.

Declaration of Conflicting Interests': The authors declare that there is no conflict of interest.

IRB protocol/human subjects approval numbers: The study and all research protocols were approved by the Institutional Review Board of the University of Texas Medical Branch (IRB#: 16-0014).

Keywords

vision; frailty; longitudinal methods; older adults; Mexican Americans

INTRODUCTION

Vision impairment (VI)—a potentially preventable disability—affects two billion persons worldwide (World Health Organization, 2023). The International Classification of Diseases (ICD-11) (2018) classified vision impairment into two groups, distance and near presenting vision impairment (World Health Organization, 2018). The ICD-11 classifies distance vision impairment (DVI) as mild (visual acuity worse than 6/12 to 6/18), moderate (visual acuity worse than 6/18 to 6/60), severe (visual acuity worse than 6/60 to 3/60), and blindness (visual acuity worse than 3/60); and near vision impairment (NVI) as near visual acuity worse than N6 or M.08 at 40 cm (World Health Organization, 2018).

VI becomes increasingly common with older age for healthy individuals due to the normal aging process such as slower tear production (Association for the Advancement of Retired Persons, 2019), decreased number of mucous cells in the conjunctiva (Merck Manual, 2022), and reduced flexibility of eye lenses (University of California Irvine Health, 2018). Furthermore, VI is more common among individuals with additional medical conditions such as diabetes, arthritis, and stroke (Court et al., 2014; Garin et al., 2014; Rogers et al., 2017; Shukla & Tripathy, 2023). Findings from the Health, Aging and Body Composition study showed that VI was associated with higher incidence of walking and stair climbing limitations over 5 years of follow-up (Swenor et al., 2015). Similarly, VI has been associated with the development of cognitive impairment over 4 years of follow-up (Ehrlich et al., 2021).

Frailty has been defined as an increased vulnerability to adverse health outcomes following stressors and is reported by Clegg et al. 2013 to be the “most problematic expression of population ageing” (Clegg et al., 2013; L. P. Fried et al., 2004). For a person to be considered frail, three or more of the following five indicators must be present: weight loss, exhaustion, weakness, slowness, and low physical activity (Linda P. Fried et al., 2004). The prevalence of frailty increases with age ranging from 9% among the youngest old to over 35% in the oldest old (Bandeen-Roche et al., 2015). Numerous factors are associated with frailty, such as older age, female sex, cognitive impairment, decreased physical activity, and smoking (Bandeen-Roche et al., 2015; Cano et al., 2011; Fabrício-Wehbe et al., 2016; Rogers et al., 2017; Trevisan et al., 2017).

Previous research examining VI and frailty among older adults demonstrated that low vision predicted frailty over time (Gonzales-Turín et al., 2021; Liljas et al., 2017; Swenor, Lee, Tian, et al., 2020). Findings from the Women’s Health and Aging Studies (WHAS), reported that non-frail participants with moderate/severe VI were 3.5 times more likely to develop frailty than those without VI over 3 years of follow-up (Swenor, Lee, Tian, et al., 2020). In the English Longitudinal Study of Ageing (ELSA), participants with poor vision had increased odds of prefrailty and frailty (2.07 and 3.24, respectively) over 4 years of follow-up (Liljas et al., 2017).

In the United States (US) alone, Varma et al. (2016) reported four million Americans had a VI and indicated that this number will double to 8 million by the year 2050 (Lopez, 2015; Varma et al., 2016), especially among Mexican American older adults, one of the fastest growing segments of older Americans (Lopez, 2015; National Eye Institute, 2022). The American Academy of Ophthalmology determined that Hispanic men — predominantly Mexican Americans — will be the largest population of Americans with low vision over the next few decades (American Academy of Ophthalmology, 2014). For example, Mexican American older adults have a high prevalence of Type 2 diabetes, one of the most common risk factors for developing VI (Wang et al., 2021). It is thus important to study and understand the impact of untreated VI/low vision on physical activity engagement, energy level, muscle strength, maintenance of healthy weight and ability to walk and move safely, all of which are criteria of frailty. Low access to quality of health care and communication barriers from language and cultural differences have been reported among Mexican American communities (Pew Research Center, 2022). Accordingly, it is essential to study VI, a potentially preventable health factor, among the Mexican American population. Findings from such study can guide the development of culturally appropriate interventions to improve physical activity engagement and mitigate onset of various criteria of frailty in Mexican American older adults.

There is paucity of research examining the long-term relationship between VI and new-onset frailty in older Mexican Americans, a population with high rates of frailty and high prevalence of vision-impairing diseases (Ottenbacher et al., 2005). Knowing the differential impact of VI on different frailty criteria can inform the design of tailored and patient-specific interventions to address VI-related frailty and help seniors age in place (Szanton et al., 2015). The purpose of this study was two-fold: 1) to determine the relationship between VI and frailty among non-frail Mexican American older adults at baseline and whether NVI or DVI (when analyzed separately) drove the relationship between VI and frailty over 18 years of follow-up after controlling for covariates; and 2) to determine the differential impact of VI on each frailty criteria after controlling for covariates. It is hypothesized that non-frail older Mexican Americans with VI will have increased odds of frailty onset over 18 years of follow-up and that VI will have a differential impact on at least three frailty criteria after controlling for covariates.

METHODS

Data Source

Data were from the Hispanic Established Populations for the Epidemiologic Study of the Elderly (H-EPESE). The H-EPESE survey collected data from Mexican Americans aged 65 years and older located in the states of Arizona, California, Colorado, New Mexico, and Texas. At baseline (1993/94), 3,050 participants were interviewed, and follow-up interviews were conducted every two or three years. Of these participants, 2435 were interviewed in Wave 2, 219 were confirmed dead through the National Death Index and reported from relatives, and 109 were lost to follow-up or refused to be reinterviewed. The present study used data obtained on 1,979 participants interviewed at Wave 3 (1998/99, hereafter baseline). The first and second wave (1993/94 and 1995/96) were not included because the

variable of self-reported VI was not collected. We used data collected from Wave 3 to Wave 9 (2016). The H-EPESE datasets are available at the National Archive of Computerized Data on Aging (Markides et al., 2016).

Of the 1,979 participants interviewed at baseline, we excluded 146 who were frail at baseline and 761 because of missing variable information on VI, frailty phenotype, or covariates, leaving a final sample size of 1,072. Participants excluded from the study were more likely to be older; to be unmarried; to have financial strain; to report comorbidities (cancer, heart attack, hip fracture, and stroke), high depressive symptoms, hearing impairment, NVI, DVI, and VI (near or distant); and to have a lower Mini-Mental State Examination (MMSE) score (Folstein et al., 1975) than included participants. At the end of follow up (2016), 175 participants were re-interviewed in person, 80 were lost to follow up or refused to be re-interviewed, and 149 were reported as deceased from the National Death Index and the decedent's relatives. Figure S1 presents the sample flow chart. At the time of interview, oral informed consent was provided for each participant and the study protocol was approved by the University's Institutional Review Board (IRB# 16–004).

Measures

Independent Variable – Vision Impairment—Vision impairment was defined in three different ways: DVI, NVI, or any VI. DVI was assessed with the following question: "When wearing your glasses/contacts can you see well enough to recognize a friend across the street or across the room?" NVI was assessed with the following question: "When wearing your glasses/contacts, can you see well enough to recognize a friend who is at arm's length away?" If NVI and/or DVI was indicated, then the participant was classified as having a VI. These questions are similar to questions utilized in the Behavioral Risk Factor Surveillance System data set for VI assessment (Centers for Disease Control and Prevention, 2021; Chou et al., 2012; McGwin et al., 2010).

Dependent Variable – Modified Frailty Phenotype—Frailty status was determined by using a modified version of the frailty phenotype defined by Fried et al. (2001) (Fried et al., 2001). The modified frailty phenotype measure used in this study was previously validated in this sample population (Li et al., 2019). The criteria were weight loss, weakness, slowness, low physical activity, and exhaustion (Fried et al., 2001; Li et al., 2019). Weight loss: >10 pounds, calculated as the difference between weight measured in 1995/96 and in 1998/99. Weakness: handgrip strength test in the bottom 20% (adjusted for sex and Body Mass Index [BMI]) or those unable to perform the test. Slowness: a timed 8-foot walk in the bottom 20% (height-sex adjusted) or unable to perform the test. Low physical activity: answered "No" to the question "Can you walk half a mile without help from anyone else?" (sex-adjusted). Exhaustion: positive responses to the following questions: "Everything I did was an effort" or "I could not get going" from the Center for Epidemiologic Studies Depression (CES-D) Scale (Radloff, 1977). Participants were classified as non-frail if they met none of the criteria, pre-frail if they met 1–2 of the criteria, and frail if they met 3 or more of the criteria. Frailty was assessed at each interview during the 18-year study period.

Covariates—Specific covariates were included in the analysis as they have been reported to be associated with VI and frailty (Afunugo et al., 2023; Court et al., 2014; Ehrlich et al., 2021; Garin et al., 2014; Ong et al., 2018; Rutherford et al., 2022; Shukla & Tripathy, 2023; Swenor et al., 2015; Ventura et al., 2023; Vetrano et al., 2018; Welch et al., 2021; Zheng et al., 2018). Covariates included socio-demographic variables (age, sex, marital status, years of education, financial strain, nativity status, language of interview, social isolation [lives with family vs. alone]), BMI, current smoking status, comorbidities (hypertension, arthritis, cancer, diabetes, heart attack, hip fracture, and stroke), hearing impairment, depressive symptoms using the CES-D (Radloff, 1977), and cognitive function assessed with the MMSE (Folstein et al., 1975).

Statistical Analysis

T-test and Chi-square tests were used to examine the distribution of the variables by VI at baseline. Mean, standard deviation (SD), and ranges were reported for continuous variables (age and years of education). Frequency and percents were reported for variables that were categorized (socio-demographics, smoking, BMI, comorbidities, cognitive impairment, depressive symptoms, and hearing impairment). T-test was performed for continuous variables with normal distribution and the p-value chosen was based on the homogeneity of variance assumption. Chi-square tests and Fisher's Exact test were conducted to test the differences of the categorical variables.

The odds ratio (OR) and 95% Confidence Interval (CI) of frailty as a function of VI were estimated using Generalized Estimating Equation (GEE) models with logit link for a binomial distribution and the autoregressive covariance structure to account for repeated measures of participants. The covariance matrixes for GEE models were chosen based on the Akaike information criterion and Bayesian information criterion values (Zeger & Liang, 1986). Using GEE models, we minimize the selection bias from missing information, since this procedure allows for the use of all available data from all follow-up interviews while accounting for differences in the follow-up duration; we therefore lose only the observations for which the participant is missing, and not all the measurements. To estimate the working correlation parameters, all non-missing pairs of data were used from the same participants over time. All models were controlled for sociodemographic and health factors over time. All variables were analyzed as time varying (potential to change over time) except for sex, education, and nativity. Age and years of education were analyzed as continuous variables in the GEE analysis and all other covariates were analyzed as categorical. Participants who died, refused to participate, or were lost to follow up were included until their last follow-up date (last interview date over the 18-year follow-up period). Analyses were performed using SAS, version 9.0 (SAS Institute, Inc., Cary, NC). A p-value of < 0.05 was considered statistically significant.

RESULTS

Table 1 presents baseline descriptive characteristics of the sample among non-frail participants at baseline. The mean age of the overall sample was 76.68 (SD ± 5.11) years, and the mean years of education was 5.15 (SD ± 3.95). The overall sample was primarily

female (57.74%), married (54.66%), US born (58.02%), had financial strain (52.15%), and were not currently smoking (89.27%). The most common comorbidities were arthritis (47.67%), hypertension (46.08%), and diabetes (26.68%). Approximately forty percent were overweight, followed by obesity category 1 (24.44%), normal weight (24.25%), obesity category 2 (10.07%), and underweight (1.31%). About twenty nine percent had a MMSE score < 21, 19.50% indicated having a hearing impairment, and 9.98% had high depressive symptoms.

Thirteen percent of Mexican American older adults reported VI. Participants with VI compared to those without VI were significantly more likely to be older (78.51 SD ± 5.76 vs. 76.41 SD ± 4.96; p-value <0.01), indicate financial strain (61.94% vs. 50.75%; p-value 0.02), and have the interview conducted in Spanish (79.10% vs 70.79%; p-value 0.05). Additionally, participants with VI compared to those without VI were significantly more likely to report co-morbid conditions such as cancer (8.96% vs. 4.37%; p-value 0.02), heart attack (7.46% vs. 3.30%; p-value 0.02), and stroke (5.22% vs. 2.03%; p-value 0.02). Lastly, participants with VI compared to those without VI were significantly more likely to have scored < 21 on the MMSE (47.76% vs. 26.01%; p-value <0.01), have high depressive symptoms (17.91% vs. 8.85%; p-value <0.01), and have hearing impairment (27.61% vs. 18.34%; p-value 0.01). No significant differences were found by sex, marital status, years of education, nativity status, living status (with family vs. alone), BMI, and smoking status.

Table 2 presents GEE models for frailty as a function of NVI (Model 1), DVI (Model 2), and VI (Model 3) over time. No significant association was found between NVI and frailty after controlling for all covariates. Participants with DVI had greater odds of developing frailty (OR=1.95, 95% CI 1.34–2.86) over time, controlling for all covariates. Participants with VI (near or distant) had greater odds of developing frailty (OR=1.89, 95% CI 1.30–2.73) over time, controlling for all covariates. Time (years), age, financial strain, arthritis, cancer, lower MMSE score, and depressive symptoms were also factors associated with greater odds of frailty. Lower odds of frailty were found for participants in all VI models who were overweight (NVI: OR=0.65, 95% CI 0.48–0.90, DVI: OR=0.65, 95% CI 0.47–0.90, VI: OR=0.65, 95% CI 0.47–0.90) and those who reported hypertension (NVI: OR=0.69, 95% CI 0.52–0.92, DVI: OR=0.70, 95% CI 0.53–0.93, VI: OR=0.70, 95% CI 0.53–0.94).

Table S1 presents GEE models for each frailty criterion as a function of NVI, DVI, and VI (near or distant) over 18 years of follow up among non-frail Mexican American older adults at baseline. Participants with NVI, DVI, or VI had greater odds of low physical activity (OR=1.94, 95% CI 1.23–3.06; OR=2.02, 95% CI 1.57–2.61; and OR=2.03, 95% CI 1.60–2.59, respectively) over time, controlling for all covariates. Those with VI had greater odds of weakness (OR=1.29, 95% CI 1.01–1.65) and those with DVI and VI had greater odds of exhaustion (OR=1.46, 95% CI 1.07–1.99 and OR=1.48, 95% CI 1.10–2.00, respectively) over time, controlling for all covariates.

DISCUSSION

The purpose of this study was to examine the longitudinal relationship between VI and frailty over 18 years of follow up among non-frail Mexican American older adults at

baseline and whether NVI or DVI (when analyzed separately) drove the relationship between VI and frailty. We found DVI and VI (NVI or DVI) were associated with frailty over time. In our study, NVI was not associated with frailty. When we examined the relationship between VI and each frailty criteria, we found VI associated with low physical activity, weakness, and exhaustion.

Some mechanisms may explain the relationship between VI and frailty. For example, VI increases the risk for low physical activity and low participation in activities of daily living, which can subsequently lead to weakness and exhaustion (Lam et al., 2013; Ong et al., 2018; Swenor et al., 2015; Welch et al., 2021). VI can also increase social isolation, which increases the risk of sedentary lifestyle and depression, which can in turn also precipitate weakness and exhaustion (Coyle et al., 2017; Tetteh et al., 2020). The negative effect of VI — on physical and cognitive function as well as on social (loneliness, decreased social engagement) and psychological (depression, anxiety) factors — leads to frailty, disability, comorbidity, and mortality (Swenor, Lee, Varadaraj, et al., 2020). VI also increases the risk of hospitalization, which is itself a risk factor for frailty (Morse et al., 2019) (Chang et al., 2018). Interventions to increase access to timely eye care among Mexican American older adults can have myriad downstream health benefits, given the well-described cardiovascular, metabolic, neurological, and psychiatric consequences of physical inactivity. In addition, Mexican Americans have known barriers to health care access related to culture and communication (Pew Research Center, 2022). Eye care diagnosis and treatment interventions from health care professionals should be adapted to decrease barriers, such as the use of a medical interpreter being standard across health care delivery systems (Hamm et al., 2021). Furthermore, individuals with language barriers are less likely to use preventative services, which may cause a delay in diagnoses of comorbidities that lead to VI (Hall et al., 2022). Additional supports for navigating the health care system may be needed to obtain appropriate vision care, such as which vision provider is most appropriate to visit (ophthalmologist vs. optometrist), identification of options for vision funding sources (insurance, underinsured, and no insurance), or assistance determining if reading glasses obtained from a local drug store are sufficient to correct current vision difficulties.

The findings of this study are similar to those found in the longitudinal study of the WHAS, the ELSA, the National Health and Aging Trends Study, and the Toledo Study for Healthy Aging, all of which found that older adults with VI had greater odds of developing frailty (Gonzales-Turín et al., 2021; Hou et al., 2022; Liljas et al., 2017; Swenor, Lee, Tian, et al., 2020). Participants who were overweight had lower odds of frailty, although prior research has shown overweight to be associated with frailty (Rutherford et al., 2022; Strandberg et al., 2012; Yuan et al., 2021). In addition, hypertension was associated with greater odds of frailty in previous studies (Vetrano et al., 2018); however, in this study, participants who reported hypertension had lower odds of frailty.

This study is unique because it is the first known study to analyze types of VI (near or distant) separately to determine if there were differences between vision impairment type and frailty criteria over time. All types of VI (near, distant, any) had the highest association with low physical activity frailty criteria when compared to other frailty criteria.

Thus, addressing VI in older Mexican Americans may increase physical activity among this population.

The present study has some limitations. First, VI was a self-reported measure and was not objectively measured using vision assessments, such as the commonly used Snellen visual acuity chart. However, self-reported VI has previously demonstrated a significant association with objectively measured VI (Zimdars et al., 2012). Second, the exclusion of participants at baseline may have underestimated the relationship between VI and frailty. Third, generalizability of the study is limited to Mexican American older adults living in the geographic region of the Southwestern US (Arizona, California, Colorado, New Mexico, and Texas). Fourth, due to longitudinal follow up over 18 years of time, attrition from loss to follow up or death occurred. However, the most appropriate statistical method of GEE modeling was used to account for this attrition limitation. There are many strengths of this study. First, our study is unique in that it included a long follow up over 18 years, using as time varying all available data on VI, socio-demographics, comorbidities, BMI, and frailty. Second, this study captured results for both self-reported NVI and DVI separately, making this study unique when compared to other longitudinal surveys which uses one definition for both NVI and DVI.

This study has several implications. Focusing on VI prevention and correction may help decrease disability related to specific frailty criteria among Mexican American older adults. VI is an important issue to address because it relates to a major cause of disability among older adults. Our findings suggest early screening (and optimal management) of VI represents an important step in preventing or delaying the onset of frailty in Mexican American older adults, a population projected to comprise the largest population of Americans with low vision in the next few decades.

Statement of research material access: The datasets generated during and/or analyzed during the current study are available at https://www.icpsr.umich.edu/icpsrweb/NACDA/series/546.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements:

I, Dr. Sonnenfeld, the corresponding author, affirm that I have listed everyone who contributed significantly to this work and have obtained written consent from all contributors who are not authors and are named in the Acknowledgement section. The authors acknowledge the assistance of Sarah Toombs Smith, PhD, ES, in article preparation.

Funders:

This work was supported in part by the National Institute on Aging (R01 AG10939), the National Institute on Minority Health and Health Disparities (R01 MD010355). Dr. Sonnenfeld is supported by the Health Professions Education Evaluation and Research (HPEER) fellowship, through the VA Office of Academic Affiliations Advanced Fellowships Program (3HPECCD2020) and the U.S. Department of Veterans Affairs Health Services Research & Development Service (VA HSR&D Grant # CIN 13-413). The content is solely the responsibility of the authors and does not necessarily represent the official views of the HPEER program or the Department of Veterans Affairs.

REFERENCES

Afunugo WE, Li CY, Chou LN, Ward F, & Al Snih S. (2023). Pain, obesity, and physical function in Mexican American older adults during 20 years of follow-up. PM R, 15(3), 331–341. 10.1002/pmrj.12805 [PubMed: 35322569]

American Academy of Ophthalmology. (2014). Eye Disease Statistics. Retrieved June 30 from https://www.aao.org/clinical-statement/eye-disease-statistics-2

Association for the Advancement of Retired Persons. (2019). How your eyes change with age. Retrieved July 26, 2023 from https://www.aarp.org/health/conditions-treatments/info-2019/eye-changes-with-age.html

Bandeen-Roche K, Seplaki CL, Huang J, Buta B, Kalyani RR, Varadhan R, Xue QL, Walston JD, & Kasper JD (2015). Frailty in Older Adults: A Nationally Representative Profile in the United States. J Gerontol A Biol Sci Med Sci, 70(11), 1427–1434. 10.1093/gerona/glv133 [PubMed: 26297656]

Cano C, Samper-Ternent R, Al Snih S, Markides K, & Ottenbacher KJ (2011). Frailty and cognitive impairment as predictors of mortality in older Mexican Americans. The Journal of nutrition, health & aging, 16(2), 142–147. 10.1007/s12603-011-0104-7

Centers for Disease Control and Prevention. (2021). Behavioral Risk Surveillance System. https://www.cdc.gov/brfss/index.html

Chang SF, Lin HC, & Cheng CL (2018). The Relationship of Frailty and Hospitalization Among Older People: Evidence From a Meta-Analysis. J Nurs Scholarsh, 50(4), 383–391. 10.1111/jnu.12397 [PubMed: 29874399]

Chou C-F, Barker LE, Crews JE, Primo SA, Zhang X, Elliott AF, McKeever Bullard K, Geiss LS, & Saaddine JB (2012). Disparities in Eye Care Utilization Among the United States Adults With Visual Impairment: Findings From the Behavioral Risk Factor Surveillance System 2006–2009. American Journal of Ophthalmology, 154(6), S45–S52.e41. 10.1016/j.ajo.2011.09.025 [PubMed: 23158223]

Clegg A, Young J, Iliffe S, Rikkert MO, & Rockwood K. (2013). Frailty in elderly people. Lancet, 381(9868), 752–762. 10.1016/s0140-6736(12)62167-9 [PubMed: 23395245]

Court H, McLean G, Guthrie B, Mercer SW, & Smith DJ (2014). Visual impairment is associated with physical and mental comorbidities in older adults: a cross-sectional study. BMC Med, 12, 181. 10.1186/s12916-014-0181-7 [PubMed: 25603915]

Coyle CE, Steinman BA, & Chen J. (2017). Visual Acuity and Self-Reported Vision Status. J Aging Health, 29(1), 128–148. 10.1177/0898264315624909 [PubMed: 26762396]

Ehrlich JR, Swenor BK, Zhou Y, & Langa KM (2021). The Longitudinal Association of Vision Impairment With Transitions to Cognitive Impairment and Dementia: Findings From the Aging, Demographics and Memory Study. J Gerontol A Biol Sci Med Sci, 76(12), 2187–2193. 10.1093/gerona/glab157 [PubMed: 34061956]

Fabrício-Wehbe SC, Rodrigues RA, Haas VJ, Fhon JR, & Diniz MA (2016). Association of frailty in hospitalized and institutionalized elderly in the community-dwelling. Rev Bras Enferm, 69(4), 691–696. 10.1590/0034-7167.2016690411i [PubMed: 27508474]

Folstein M, Folstein S, & McHugh P. (1975). Mini-mental state. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res, 12(3), 189–198. [PubMed: 1202204]

Fried LP, Ferrucci L, Darer J, Williamson JD, & Anderson G. (2004). Untangling the concepts of disability, frailty, and comorbidity: implications for improved targeting and care. J Gerontol A Biol Sci Med Sci, 59(3), 255–263. 10.1093/gerona/59.3.m255 [PubMed: 15031310]

Fried LP, Ferrucci L, Darer J, Williamson JD, & Anderson G. (2004). Untangling the Concepts of Disability, Frailty, and Comorbidity: Implications for Improved Targeting and Care. The journals of gerontology. Series A, Biological sciences and medical sciences, 59(3), M255–M263. 10.1093/gerona/59.3.M255

Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G, & McBurnie MA (2001). Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci, 56(3), M146–156. 10.1093/gerona/56.3.m146 [PubMed: 11253156]

Garin N, Olaya B, Lara E, Moneta MV, Miret M, Ayuso-Mateos JL, & Haro JM (2014). Visual impairment and multimorbidity in a representative sample of the Spanish population. BMC Public Health, 14, 815. 10.1186/1471-2458-14-815 [PubMed: 25103270]

Gonzales-Turín JM, Rodríguez-Laso Á, Carnicero JA, García-García FJ, & Rodríguez-Mañas L. (2021). Relationship between self-reported visual impairment and worsening frailty transition states in older people: a longitudinal study. Aging Clinical and Experimental Research. 10.1007/s40520-020-01768-w

Hall IJ, Rim SH, & Dasari S. (2022). Preventive care use among Hispanic adults with limited comfort speaking English: An analysis of the Medical Expenditure Panel Survey data. Prev Med, 159, 107042. 10.1016/j.ypmed.2022.107042

Hamm LM, Yashadhana A, Burn H, Black J, Grey C, Harwood M, Peiris-John R, Burton MJ, Evans JR, & Ramke J. (2021). Interventions to promote access to eyecare for non-dominant ethnic groups in high-income countries: a scoping review. BMJ Glob Health, 6(9). 10.1136/bmjgh-2021-006188

Hou T, Liu M, & Zhang J. (2022). Bidirectional association between visual impairment and frailty among community-dwelling older adults: a longitudinal study. BMC Geriatrics, 22(1). 10.1186/s12877-022-03365-0

Lam BL, Christ SL, Zheng DD, West SK, Munoz BE, Swenor BK, & Lee DJ (2013). Longitudinal relationships among visual acuity and tasks of everyday life: the Salisbury Eye Evaluation study. Invest Ophthalmol Vis Sci, 54(1), 193–200. 10.1167/iovs.12-10542 [PubMed: 23221066]

Li CY, Al Snih S, Chen NW, Markides KS, Sodhi J, & Ottenbacher KJ (2019). Validation of the Modified Frailty Phenotype Measure in Older Mexican Americans. J Am Geriatr Soc, 67(11), 2393–2397. 10.1111/jgs.16104 [PubMed: 31414494]

Liljas AEM, Carvalho LA, Papachristou E, De Oliveira C, Wannamethee SG, Ramsay SE, & Walters KR (2017). Self-reported vision impairment and incident prefrailty and frailty in English community-dwelling older adults: findings from a 4-year follow-up study. J Epidemiol Community Health, 71(11), 1053–1058. 10.1136/jech-2017-209207 [PubMed: 28798152]

Lopez G. (2015). Hispanics of Puerto Rican Origin in the United States, 2013. https://www.pewresearch.org/hispanic/2015/09/15/hispanics-of-mexican-origin-in-the-united-states-2013/

Markides KS, Chen N-W, Angel R, & Palmer R. (2016). Hispanic Established Populations for the Epidemiologic Study of the Elderly (HEPESE) Wave 8, 2012–2013 [Arizona, California, Colorado, New Mexico, and Texas] Inter-university Consortium for Political and Social Research [distributor]. 10.3886/ICPSR36578.v2

McGwin G, Khoury R, Cross J, & Owsley C. (2010). Vision Impairment and Eye Care Utilization among Americans 50 and Older. Current eye research, 35(6), 451–458. 10.3109/02713681003664931 [PubMed: 20465437]

Manual Merck. (2022). Effects of aging on the eyes. Retrieved July 26, 2023 from Association for the Advancement of Retired Persons

Morse AR, Seiple W, Talwar N, Lee PP, & Stein JD (2019). Association of Vision Loss With Hospital Use and Costs Among Older Adults. JAMA Ophthalmology, 137(6), 634. 10.1001/jamaophthalmol.2019.0446 [PubMed: 30946451]

National Eye Institute. (2022). Eye health among Hispanics/Latinos. Retrieved August 8, 2023 from https://www.nei.nih.gov/learn-about-eye-health/outreach-resources/eye-health-among-hispanicslatinos

Ong SR, Crowston JG, Loprinzi PD, & Ramulu PY (2018). Physical activity, visual impairment, and eye disease. Eye (Lond), 32(8), 1296–1303. 10.1038/s41433-018-0081-8 [PubMed: 29610523]

Ottenbacher KJ, Ostir GV, Peek MK, Snih SA, Raji MA, & Markides KS (2005). Frailty in Older Mexican Americans. Journal of the American Geriatrics Society (JAGS), 53(9), 1524–1531. 10.1111/j.1532-5415.2005.53511.x

Pew Research Center. (2022). Hispanic Americans' experiences with health care. Retrieved July 26, 2023 from https://www.pewresearch.org/science/2022/06/14/hispanic-americans-experiences-with-health-care/

Radloff LS (1977). The CED-D scale: A self-report depression scale for research in the general population. Applied Psychological Measurement, 1, 385–401.

Rogers NT, Marshall A, Roberts CH, Demakakos P, Steptoe A, & Scholes S. (2017). Physical activity and trajectories of frailty among older adults: Evidence from the English Longitudinal Study of Ageing. PLoS One, 12(2), e0170878. 10.1371/journal.pone.0170878

Rutherford M, Downer B, Li C-Y, Chou L-N, & Al Snih S. (2022). Body mass index and physical frailty among older Mexican Americans: Findings from an 18-year follow up. PLoS One, 17(9), e0274290. 10.1371/journal.pone.0274290

Shukla UV, & Tripathy K. (2023). Diabetic Retinopathy. In StatPearls. StatPearls Publishing Copyright © 2023, StatPearls Publishing LLC.

Strandberg TE, Sirola J, Pitkälä KH, Tilvis RS, Strandberg AY, & Stenholm S. (2012). Association of midlife obesity and cardiovascular risk with old age frailty: a 26-year follow-up of initially healthy men. Int J Obes (Lond), 36(9), 1153–1157. 10.1038/ijo.2012.83 [PubMed: 22614054]

Swenor BK, Lee MJ, Tian J, Varadaraj V, & Bandeen-Roche K. (2020). Visual Impairment and Frailty: Examining an Understudied Relationship. J Gerontol A Biol Sci Med Sci, 75(3), 596–602. 10.1093/gerona/glz182 [PubMed: 31419280]

Swenor BK, Lee MJ, Varadaraj V, Whitson HE, & Ramulu PY (2020). Aging With Vision Loss: A Framework for Assessing the Impact of Visual Impairment on Older Adults. Gerontologist, 60(6), 989–995. 10.1093/geront/gnz117 [PubMed: 31504483]

Swenor BK, Simonsick EM, Ferrucci L, Newman AB, Rubin S, & Wilson V. (2015). Visual impairment and incident mobility limitations: the health, aging and body composition study. J Am Geriatr Soc, 63(1), 46–54. 10.1111/jgs.13183 [PubMed: 25536849]

Szanton SL, Wolff JL, Leff B, Roberts L, Thorpe RJ, Tanner EK, Boyd CM, Xue QL, Guralnik J, Bishai D, & Gitlin LN (2015). Preliminary data from community aging in place, advancing better living for elders, a patient-directed, team-based intervention to improve physical function and decrease nursing home utilization: the first 100 individuals to complete a centers for medicare and medicaid services innovation project. J Am Geriatr Soc, 63(2), 371–374. 10.1111/jgs.13245 [PubMed: 25644085]

Tetteh J, Fordjour G, Ekem-Ferguson G, Yawson AO, Boima V, Entsuah-Mensah K, Biritwum R, Essuman A, Mensah G, & Yawson AE (2020). Visual impairment and social isolation, depression and life satisfaction among older adults in Ghana: analysis of the WHO's Study on global AGEing and adult health (SAGE) Wave 2. BMJ Open Ophthalmol, 5(1), e000492. 10.1136/bmjophth-2020-000492

Trevisan C, Veronese N, Maggi S, Baggio G, Toffanello ED, Zambon S, Sartori L, Musacchio E, Perissinotto E, Crepaldi G, Manzato E, & Sergi G. (2017). Factors Influencing Transitions Between Frailty States in Elderly Adults: The Progetto Veneto Anziani Longitudinal Study. Journal of the American Geriatrics Society (JAGS), 65(1), 179–184. 10.1111/jgs.14515

. (2018). Oh my aging eyes! What can I do to preserve sight? Retrieved July 26, 2023 from https://www.ucihealth.org/blog/2018/03/aging-eye

Varma R, Vajaranant TS, Burkemper B, Wu S, Torres M, Hsu C, Choudhury F, & McKean-Cowdin R. (2016). Visual Impairment and Blindness in Adults in the United States: Demographic and Geographic Variations From 2015 to 2050. JAMA Ophthalmol, 134(7), 802–809. 10.1001/jamaophthalmol.2016.1284 [PubMed: 27197072]

Ventura J, Downer B, Li CY, & Snih SA (2023). Nativity differences in the relationship between handgrip strength and cognitive impairment in older Mexican Americans over 20 years of follow-up. Arch Gerontol Geriatr, 107, 104903. 10.1016/j.archger.2022.104903

Vetrano DL, Palmer KM, Galluzzo L, Giampaoli S, Marengoni A, Bernabei R, & Onder G. (2018). Hypertension and frailty: a systematic review and meta-analysis. BMJ Open, 8(12), e024406. 10.1136/bmjopen-2018-024406

Wang L, Li X, Wang Z, Bancks MP, Carnethon MR, Greenland P, Feng YQ, Wang H, & Zhong VW (2021). Trends in Prevalence of Diabetes and Control of Risk Factors in Diabetes Among US Adults, 1999–2018. Jama, 326(8), 1–13. 10.1001/jama.2021.9883

Welch SA, Ward RE, Beauchamp MK, Leveille SG, Travison T, & Bean JF (2021). The Short Physical Performance Battery (SPPB): A Quick and Useful Tool for Fall Risk Stratification Among Older Primary Care Patients. J Am Med Dir Assoc, 22(8), 1646–1651. 10.1016/j.jamda.2020.09.038 [PubMed: 33191134]

World Health Organization. (2018). Blindness and vision impairment. Retrieved August 8, 2023 from https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment

World Health Organization. (2023). Blindness and vision impairment. Retrieved September 19, 2023 from https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment

Yuan L, Chang M, & Wang J. (2021). Abdominal obesity, body mass index and the risk of frailty in community-dwelling older adults: a systematic review and meta-analysis. Age Ageing, 50(4), 1118–1128. 10.1093/ageing/afab039 [PubMed: 33693472]

Zeger SL, & Liang KY (1986). Longitudinal data analysis for discrete and continuous outcomes. Biometrics, 42(1), 121–130. [PubMed: 3719049]

Zheng DD, Swenor BK, Christ SL, West SK, Lam BL, & Lee DJ (2018). Longitudinal Associations Between Visual Impairment and Cognitive Functioning: The Salisbury Eye Evaluation Study. JAMA Ophthalmol, 136(9), 989–995. 10.1001/jamaophthalmol.2018.2493 [PubMed: 29955805]

Zimdars A, Nazroo J, & Gjonça E. (2012). The circumstances of older people in England with self-reported visual impairment: A secondary analysis of the English Longitudinal Study of Ageing (ELSA). The British journal of visual impairment, 30(1), 22–30. 10.1177/0264619611427374

What the paper adds

- Vision impairment (VI) was associated with frailty among Mexican American older adults.
- When VI was analyzed separately for distant and near VI, greater odds of frailty were found for participants with distant VI, while no significant association was found between near VI and new-onset frailty.
- Low physical activity, exhaustion, and weakness frailty criteria were the most affected among Mexican American older adults with VI.

Applications of study findings

- Minority populations are underserved and have low access to care; addressing VI among older Mexican Americans can prevent or delay the onset of frailty.
- Vision health screening should be included as a core concept when addressing frailty among older adults.
- Treating VI can reduce the impact on specific frailty criteria.

Table 1.

Baseline descriptive characteristics of the overall sample and by vision impairment (near or distant) among Mexican American older adults (n=1072).

Characteristic	Total n (%)	Vision Impairment	No Vision Impairment	p-value
Total	1072 (100)	134 (12.50)	938 (87.50)	
Age (years), Mean ± SD, range	76.68 ± 5.11, (70–103)	78.51 ± 5.76, (70–103)	76.41 ± 4.96, (70–93)	<0.01
Sex				0.50
Female	619 (57.74)	81 (60.45)	538 (57.36)	
Male	453 (42.26)	53 (39.55)	400 (42.64)	
Marital Status				0.55
Married	586 (54.66)	70 (52.24)	516 (55.75)	
Not married	486 (45.34)	51 (38.06)	462 (49.25)	
Education (years), Mean ± SD, range	5.15 ± 3.95, (0–20)	4.99 ± 3.61, (0–17)	5.17 ± 4.00, (0–20)	0.60
Financial Strain				0.02
Yes	559 (52.15)	83 (61.94)	476 (50.75)	
No	513 (47.85)	51 (38.06)	462 (49.25)	
Nativity Status				0.48
US born	622 (58.02)	74 (55.22)	548 (58.42)	
Foreign born	450 (41.98)	60 (44.78)	390 (41.58)	
Language of Interview				0.05
Spanish	770 (71.83)	106 (79.10)	664 (70.79)	
English	302 (28.17)	28 (20.90)	274 (29.21)	
Lives with family				0.63
Yes	810 (75.56)	99 (73.88)	711 (75.80)	
No	262 (24.44)	35 (26.12)	227 (24.20)	
Hypertension				0.18
Yes	494 (46.08)	69 (51.49)	425 (45.31)	
No	578 (53.92)	65 (48.51)	513 (54.69)	
Arthritis				0.34
Yes	511 (47.67)	69 (51.49)	442 (47.12)	
No	561 (52.33)	65 (48.51)	496 (52.88)	
Cancer				0.02
Yes	53 (4.94)	12 (8.96)	41 (4.37)	
No	1019 (95.06)	122 (91.04)	897 (95.63)	
Diabetes				0.37
Yes	286 (26.68)	40 (29.85)	246 (26.23)	
No	786 (73.32)	94 (70.15)	692 (73.77)	
Heart Attack				0.02
Yes	41 (3.82)	10 (7.46)	31 (3.30)	
No	1031 (96.18)	124 (92.54)	907 (96.70)	

Characteristic	Total n (%)	Vision Impairment	No Vision Impairment	p-value
Hip fracture				0.22
Yes	9 (0.84)	2 (1.49)	7 (0.75)	
No	1063 (99.16)	132 (98.51)	931 (99.25)	
Stroke				0.02
Yes	26 (2.43)	7 (5.22)	19 (2.03)	
No	1046 (97.57)	127 (94.78)	919 (97.97)	
BMI Categories				
Underweight	14 (1.31)	1 (0.75)	13 (1.39)	0.31
Normal	260 (24.25)	34 (25.37)	226 (24.09)	0.75
Overweight	428 (39.93)	56 (41.79)	372 (39.66)	0.64
Obese Category 1	262 (24.44)	30 (22.39)	232 (24.73)	0.55
Obese Category 2	108 (10.07)	13 (9.70)	95 (10.13)	0.88
Cognitive Impairment				<0.01
Yes (MMSE < 21)	308 (28.73)	64 (47.76)	244 (26.01)	
No (MMSE ≥ 21)	764 (71.27)	70 (52.24)	694 (73.99)	
Depressive symptoms				<0.01
Yes (CES-D ≥ 16)	107 (9.98)	24 (17.91)	83 (8.85)	
No (CES-D < 16)	965 (90.02)	110 (82.09)	855 (91.15)	
Current Smoking				0.28
Yes	115 (10.73)	18 (13.43)	97 (10.34)	
No	957 (89.27)	116 (86.57)	841 (89.66)	
Hearing Impairment				0.01
Yes	209 (19.50)	37 (27.61)	172 (18.34)	
No	863 (80.50)	97 (72.39)	766 (81.66)	

Abbreviations: SD=standard deviation; US=United States; BMI=body mass index; MMSE=Mini Mental State Exam; CES-D=Center for Epidemiologic Studies Depression Scale; kg=kilograms; m=meters

Note: p-values for continuous variables were obtained using t-test and p-values for nominal or categorical variables were obtained using Chi-square tests or Fisher's Exact Test.

Table 2.

Generalized Estimating Equation models for frailty as a function of vision impairment over 18-years of follow up among non-frail Mexican American older adults at baseline (N=1072).

	Model 1	Model 2	Model 3
Predictors	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Time	1.22 (1.18–1.26)	1.22 (1.18–1.26)	1.22 (1.18–1.26)
Near VI	1.67 (0.87–3.21)		
Distant VI		1.95 (1.34–2.86)	
VI			1.89 (1.30–2.73)
Age (years)	1.07 (1.04–1.10)	1.07 (1.03–1.10)	1.07 (1.04–1.10)
Female	1.06 (0.75–1.48)	1.05 (0.75–1.47)	1.05 (0.75–1.47)
Married	0.93 (0.66–1.32)	0.94 (0.66–1.34)	0.93 (0.66–1.32)
Education (years)	1.00 (0.96–1.04)	1.00 (0.96–1.04)	1.00 (0.96–1.04)
Financial Strain	1.52 (1.14–2.03)	1.49 (1.11–1.99)	1.49 (1.12–2.00)
Nativity (Foreign born)	0.98 (0.72–1.34)	0.99 (0.73–1.36)	0.99 (0.72–1.34)
Spanish Interview	0.94 (0.64–1.38)	0.94 (0.64–1.39)	0.94 (0.64–1.39)
Lives with Family	1.23 (0.87–1.75)	1.22 (0.86–1.72)	1.23 (0.87–1.73)
Current Smoking	1.40 (0.81–2.40)	1.33 (0.77–2.31)	1.34 (0.78–2.33)
BMI Categories			
Underweight	2.15 (0.96–4.84)	2.10 (0.92–4.85)	2.13 (0.92–4.89)
Normal	Reference	Reference	Reference
Overweight	0.65 (0.48–0.90)	0.65 (0.47–0.90)	0.65 (0.47–0.90)
Obesity Category 1	0.86 (0.57–1.31)	0.86 (0.56–1.30)	0.86 (0.57–1.30)
Obesity Category 2	1.27 (0.75–2.16)	1.28 (0.76–2.18)	1.28 (0.76–2.17)
Hypertension	0.69 (0.52–0.92)	0.70 (0.53–0.93)	0.70 (0.53–0.94)
Arthritis	1.42 (1.06–1.90)	1.40 (1.05–1.88)	1.41 (1.05–1.88)
Cancer	1.88 (1.16–3.05)	1.81 (1.12–2.94)	1.83 (1.13–2.97)
Diabetes	1.10 (0.80–1.52)	1.12 (0.81–1.54)	1.12 (0.81–1.54)
Heart Attack	1.08 (0.61–1.94)	1.01 (0.56–1.81)	1.02 (0.57–1.83)
Hip Fracture	2.08 (0.82–5.25)	1.93 (0.76–4.89)	1.95 (0.77–4.93)
Stroke	1.35 (0.72–2.55)	1.36 (0.73–2.53)	1.36 (0.73–2.53)
Cognitive Impairment (MMSE < 21)	1.51 (1.11–2.06)	1.42 (1.03–1.95)	1.42 (1.03–1.95)
Depressive symptoms (CES-D ≥ 16)	4.69 (3.45–6.38)	4.48 (3.29–6.11)	4.51 (3.31–6.15)
Hearing impairment	0.97 (0.69–1.36)	0.96 (0.69–1.35)	0.95 (0.68–1.32)

Abbreviations: VI=vision impairment; OR=odds ratio; CI=confidence interval; BMI=body mass index; MMSE=Mini Mental State Exam; CES-D=Center for Epidemiologic Studies Depression Scale