Visual Impairment and Living in Poverty Are Associated in Wisconsin

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ABSTRACT

Introduction: Studies have found that the odds of visual impairment decrease as affluence increases. This retrospective cross-sectional study evaluates the association between poverty status and visual impairment in Wisconsin.

Methods: The Survey of the Health of Wisconsin (SHOW) is a household-based study that collects health and demographic data from a representative sample of Wisconsin residents. Participants with demographic, income, and vision data collected at Timepoint 1 (2008-2013) were included. Self-reported eyesight quality was categorized into visual impairment scores: none/mild, moderate, and severe. Univariable and multivariable logistic regression models, adjusting for demographic characteristics, were used to evaluate the association of visual impairment with poverty status. Longitudinal analysis investigated the relationship between visual impairment and incident poverty for participants with Timepoint 2 (2017) data.

Results: There were 3292 participants included in Timepoint 1 analysis. Multivariable analysis revealed that poverty was associated with visual impairment: compared with those with no/mild visual impairment, those with moderate visual impairment had greater odds of living in poverty [Odds Ratio (OR), 2.43; 95% CI, 1.59-3.71; $P < .001$], as did those with severe visual impairment (OR, 2.69; 95% CI, 1.26-5.72; $P = .01$). Among 706 participants in the longitudinal analysis, visual impairment was associated with incident poverty: those with moderate visual impairment were more likely to become impoverished over time compared with those without visual impairment (OR, 2.79; 95% CI, 1.01-7.77; $P = .05$).

Conclusions: Poverty is associated with subjective visual impairment in Wisconsin. Subjective visual impairment is also associated with incident poverty, suggesting a bidirectional relationship between poverty and vision impairment.

INTRODUCTION

Social determinants of health, including income, strongly influence health outcomes around the world. The Healthy People 2030 initiative of the US Department of Health and Human Services has identified social determinants of health as one of 3 priority areas for improving health in the United States,[1,2] and the World Health Organization's Commission on Social Determinants of Health (2005-2008) recommended addressing wealth inequality as an important means of improving health for global populations.[3] In ophthalmology, studies have shown that the prevalence of blindness and a country's economic development are inversely related;[4] most studies conclude that the risk of visual impairment is higher in more impoverished groups.[5,6]

Studies have found that the odds of visual impairment decrease substantially as affluence increases in many countries, suggesting that poverty increases the impairment risk.[7-12] Reversible causes of blindness, such as cataracts, are more common among individuals of lower socioeconomic status, potentially due to limited access to health care. For example, members of poorer households in 1 Nigerian study were 6 times more likely to be blind from cataracts compared to members of affluent households.[8] Access to adequate health care, such as eye exams, corrective lenses, and cataract surgery, is better in more affluent regions in multiple countries.[9,13,14] Conversely, individuals with impaired vision have been shown to have lower employment rates than the general population,[15] which may lead to higher poverty rates, suggesting a bidirectional relationship between poverty and vision

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impairment. This association between income and poverty status with visual impairment has also been noted in pediatric populations.[16,17]

Most prior research on socioeconomic risk factors for visual impairment has been conducted in other countries, but several US studies have found an inverse relationship between visual impairment and annual income.[18-21] Williams and Sahel reviewed social determinants of health as they pertain to vision in both US and international populations and cited studies showing an inverse relationship between income level and visual impairment, complexity of care, and eye care utilization.[22] Analysis of data from the National Health and Nutrition Examination Survey (NHANES) and National Health Interview Survey (NHIS) found that participants with lower income were less likely to visit eye doctors or be able to afford glasses.[23] In Wisconsin, the Beaver Dam Eye Study found that lower education and income were associated with cataract formation, need for cataract surgery, and impaired vision scores in a Wisconsin-based population examined from 1988 to 1990.[21]

Our study aimed to investigate the association between vision impairment and poverty in a contemporary Wisconsin population using data from the Survey of the Health of Wisconsin (SHOW). This study also investigates this relationship longitudinally, which, to the authors' knowledge, has not been done before. This may shed light on a link between vision impairment and incident poverty.

METHODS

Study Design

Since 2008, SHOW has conducted waves of cross-sectional and longitudinal surveys to examine social determinants of health and population health in Wisconsin adults as part of the University of Wisconsin's Real-World Evidence to Advance Community Health (REACH) program.[24,25] Individuals in households representative of the Wisconsin population were interviewed and administered questionnaires, with increased sampling of previously unrepresented groups. Survey weights were used to increase the representativeness of the data collected at Timepoint 1 (2008-2013). The survey weights incorporate design weights and adjustments for nonresponse and poststratification, calibrated to the US 2010 Census population totals by age, sex, and race.[25]

A subset of Timepoint 1 participants was resurveyed at Timepoint 2 (2017). Eligibility for Timepoint 2 participation included consenting to be contacted by SHOW for future studies and living in select counties that covered the full spectrum of urbanicity and county health rankings across Wisconsin. Certain counties and populations were selected to avoid underrepresentation and increase the generalizability of the data to the wider Wisconsin population. This study analyzes data collected at Timepoint 1 (2008-2013) and the longitudinal follow-up at Timepoint 2 (2017).

Table. Study Participant Characteristics

Variable	Frequency (%) Timepoint 1 (n = 3292)	Timepoint 2 (n = 706)
Visual impairment score		
None to mild	2887 (88%)	607 (86%)
Moderate	324 (10%)	76 (11%)
Severe	81 (2%)	23 (3%)
No response	0 (0%)	0 (0%)
Age (years), mean	47.3 (±14.4)	53.8 (±13.9)
Individual annual income (USD), mean	$37 110	$45 414
Sex		
Male	1445 (44%)	284 (40%)
Female	1847 (56%)	422 (60%)
Race/ethnicity		
Non-Hispanic White	2801 (85%)	559 (79%)
Non-Hispanic Black	232 (7%)	93 (13%)
Hispanic	107 (3%)	22 (3%)
Other/multiracial	148 (5%)	30 (4%)
No response	4 (<1%)	2 (<1%)
Education		
≤ High school education	844 (26%)	159 (23%)
> High school education	2445 (74%)	547 (77%)
No response	3 (<1%)	0 (0%)
Incarceration status		
Not incarcerated in the last year	2852 (87%)	609 (86%)
Incarcerated in the last year	40 (1%)	5 (1%)
No response	400 (12%)	92 (13%)
Insurance status		
Insured for 12 months	2769 (84%)	665 (94%)
Insured for <12 months	515 (16%)	40 (6%)
No Response	8 (<1%)	1 (<1%)
Poverty status		
Below the federal poverty level	402 (12%)	60 (8%)
Above the federal poverty level	2890 (88%)	646 (92%)
No response	0 (0%)	0 (0%)

Abbreviations: USD, US dollars.

Self-reported demographic variables analyzed in this study include age, sex, race/ethnicity, postsecondary education, history of recent incarceration, and health insurance status. A participant was considered to have an incarceration history if they reported jail or other institutional detention in the previous 12 months. A participant was considered to have health insurance if they reported coverage for all 12 months of the previous year.

Poverty status was determined by comparing the participant's reported combined household income from the previous 12 months (before taxes) with the reported number of people supported by that income. This was then compared to the federal poverty level (FPL) of the year of data collection.[26]

To assess vision, participants were asked, "At the present time, would you say your eyesight, with glasses or contact lenses, if you wear them, is excellent, good, fair, poor, or very poor?" Participant responses were grouped into visual impairment scores: "excellent" and "good" were categorized as "No/Mild Visual Impairment;" "fair" as "Moderate Visual Impairment;" "poor" and "very poor"

as "Severe Visual Impairment." This question originated from NHANES.[27]

The study population excluded SHOW participants who did not respond to either the household income question or the subjective visual quality question. The longitudinal analysis excluded participants who did not respond to both questions at both timepoints.

The SHOW protocol and informed consent documents were approved by the University of Wisconsin-Madison Health Sciences Institutional Review Board. This study adhered to the tenets of the Declaration of Helsinki.

Figure 1. Visual Impairment Scores of Participants Living Above the Federal Poverty Level (A) and Below the Federal Poverty Level (B) at Timepoint 1

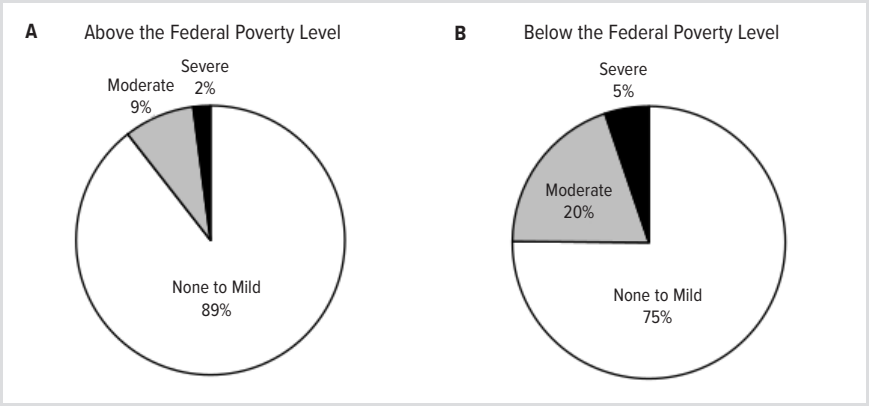
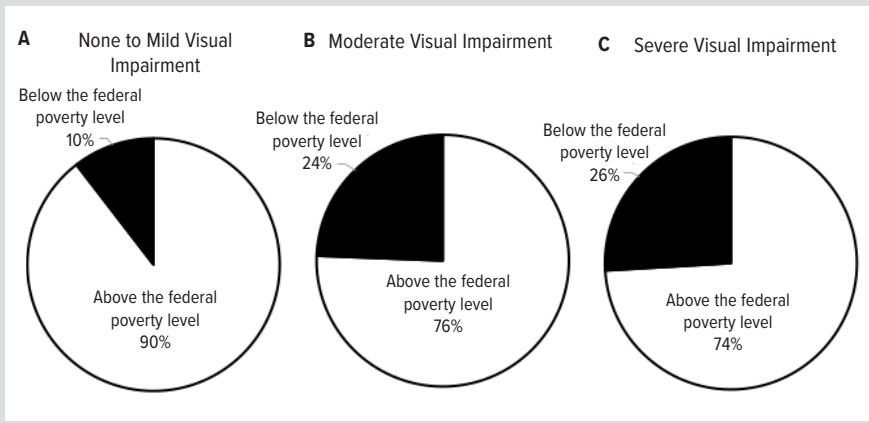


Figure 2. Poverty Status of Participants With No or Mild Visual Impairment (A), Moderate Visual Impairment (B), and Severe Visual Impairment (C) at Timepoint 1



Statistical Analysis

StataSE 17.0 (StataCorp LLC) was used for data analysis. Chi-square analysis was used to compare demographic characteristics between our study population and the full SHOW group. Univariable and multivariable logistic regression analyses utilizing survey weights were used to compare vision and demographic variables to poverty status at Timepoint 1. The longitudinal analysis involved univariable and multivariable logistic regressions comparing visual impairment scores at Timepoint 1 with incident poverty from Timepoint 1 to Timepoint 2. Poverty at Timepoint 1 was also compared with incident visual impairment at Timepoint 2. Statistical significance was defined as $P \leq .05$ for this hypothesis-generating study.

RESULTS

Population Characteristics

A total of 3292 participants were included in the Timepoint 1 analysis (97% of the 3380 total SHOW participants). A total of 706 participants were eligible for the longitudinal analysis (97% of the 725 total longitudinal SHOW participants).

Population characteristics are displayed in the Table. Age and income data were normally distributed. Most participants were female, non-Hispanic White, had more than a high school education, no incarceration history, health insurance, and income above the FPL. There were no significant demographic differences between our study population, and the total SHOW population or among our Timepoint 1 and Timepoint 2 subgroups.

Of the individuals living above the FPL at Timepoint 1, 89% had no/mild visual impairment, 9% had moderate visual impairment, and 2% had severe visual impairment. Of the individuals living below the FPL at Timepoint 1, 75% had no/mild visual impairment, 20% had moderate visual impairment, and 5% had severe visual impairment (Figure 1). At Timepoint 1, of the individuals with no or mild visual impairment, 90% lived above the FPL and 10% lived below. Of those with moderate visual impairment, 76% lived above the FPL and 24% lived below. Of those with severe visual impairment, 74% lived above the FPL and 26% lived below (Figure 2).

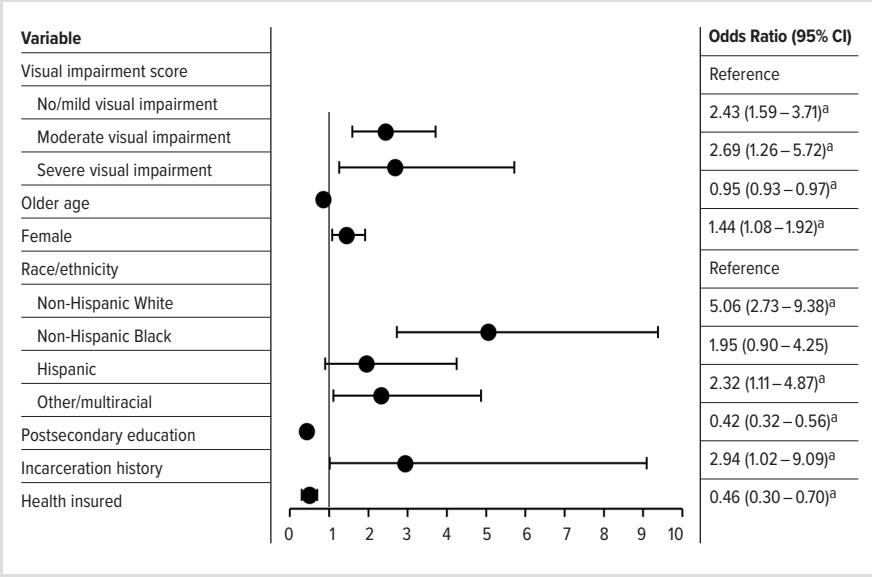
Timepoint 1 Analysis

Univariable logistic regression found that younger age, female sex, non-Hispanic Black and other/multiracial race/ethnicity, lack of postsecondary education, incarceration history, and lack of health insurance were all significantly associated with poverty.

A multivariable logistic regression model was built to evaluate the association between poverty and visual impairment, adjusting for age, sex, race/ethnicity, educational attainment, incarceration history, and health insurance status (Figure 3). Individuals with moderate and severe visual impairment were 2.43 times (OR, 2.43; 95% CI, 1.59-3.71; $P < .001$) and 2.69 times (OR, 2.69;

95% CI, 1.26-5.72; $P = .01$) more likely to live in poverty than those with no/mild visual impairment, respectively. Younger age, female sex, non-Hispanic Black and other/multiracial ethnicity, lack of post-secondary education, and incarceration history were all also associated with living in poverty in the multivariable model.

Figure 3. Odds Ratios for Living Below the Federal Poverty Level at Timepoint 1 in a Multivariable Analysis That Included All Variables LIsted



a$P < .05$.

Longitudinal Analysis

Incident poverty (poverty at Timepoint 2 but not Timepoint 1) was compared with baseline vision and demographic characteristics. Twenty-two participants (3% of the longitudinal study population) fell below the poverty line between Timepoint 1 and Timepoint 2. In a univariable analysis, participants with moderate visual impairment were 3.26 times more likely to enter poverty than those with no or mild visual impairment (OR, 3.26; 95% CI, 1.23-8.69; $P = .02$). Those with severe visual impairment were also 3.26 times more likely to enter poverty (OR, 3.26; 95% CI, 0.40-26.77; $P = .27$), though this was not statistically significant.

After adjusting for age, sex, race/ethnicity, and educational attainment, individuals with moderate visual impairment were 2.79 times more likely to become impoverished over time compared to those with no or mild visual impairment (OR, 2.79; 95% CI, 1.00-7.77; $P = .05$). Those with severe visual impairment were 2.84 times more likely to become impoverished (OR, 2.84; 95% CI, 0.32-25.0; $P = .35$), which was not statistically significant. Other demographic variables were not associated with incident poverty.

Incident visual impairment (worse visual impairment score at Timepoint 2) was also compared with baseline poverty status. Participants with baseline poverty were 2.95 times more likely to report a subjective decrease in vision between timepoints (OR, 2.95; 95% CI, 1.64-5.34; $P < .001$). However, after adjusting for age, sex, race/ethnicity, and post-secondary education, this relationship was no longer significant (OR, 1.87; 95% CI, 0.89-3.92; $P = .10$).

DISCUSSION

In this representative sample of Wisconsin adults, visual impairment is associated with both prevalent and incident poverty. Severe visual impairment showed a stronger association with poverty than mild impairment. The association with prevalent poverty is consistent with previous studies showing higher visual impairment risk in impoverished groups,[4-6] including the Beaver Dam Eye Study.[21] Our study also confirms that certain demographic factors—younger age, female sex, non-White ethnicity, lower educational attainment, incarceration history, and lack of health insurance—carry increased odds of living below the FPL, consistent with US Census Bureau data.[28]

Previous studies exploring the relationship between visual impairment and poverty have not investigated this relationship longitudinally. This study identified a positive association between moderate visual impairment and incident poverty. Lower employment rates among individuals with visual impairment may drive these higher poverty rates.[15] After controlling for demographics, we did not find a significant relationship between baseline poverty and incident vision impairment, suggesting that vision loss may be a driver of low income rather than the inverse.

Several mediators may influence this bidirectional relationship. For example, low vision may hinder job acquisition, and employment support for visually impaired workers may be inadequate. Furthermore, workers with low vision may require more medical leave. Conversely, impoverished individuals may have higher levels of visual impairment due to increased rates of eye disease, including conditions like cataracts and diabetic retinopathy,[8,21,29] coupled with decreased access to health care, corrective lenses, and cataract surgery.[9,13,14] Implementing or expanding routine vision screening programs for adults may help bridge this gap by identifying impairment early and connecting high-risk individuals with both ophthalmic care and social services.[30] Chronic stress from poverty may also exacerbate systemic illnesses such as diabetes and hypertension, further affecting ocular health. The association between visual impairment and poverty status is surely complex and merits further consideration.

Limitations

A primary limitation of this study is the use of subjective vision status. While studies have shown that self-reported vision assessments are a suitable indicator of visual impairment when compared with visual acuity testing,[31] some studies suggest that they can be subject to bias. For instance, a study examining the concordance of self-reported vision status and visual acuity found that Black participants and those with lower educational attainment were more likely to be "visually optimistic," reporting higher vision scores despite worse objective acuity.[32] Age has also been shown to cause discrepancies in self-reported vision status, with older individuals underestimating their visual impairment.[33,34] A recent study found that sex, ethnicity, income status, additional medical comorbidities, and depressive and anxiety symptoms also influence self-reported vision impairment.[34] However, the cohort in that study differs from our study population as it only included individuals over age 65 insured by Medicare and may disproportionately exclude individuals at the extremes of income and those who are not insured.

Thus, while it has limitations, self-reported vision status has been widely used to estimate visual impairment and validated in national surveys, such as NHANES, and is often the only measure of visual impairment available in large population-based health surveys.[27,35]

Another study limitation is that the Timepoint 2 analysis included a smaller sample size than the Timepoint 1 analysis, potentially introducing response bias. However, the demographic characteristics of our study groups did not differ significantly from the baseline SHOW population. The lack of survey weights for Timepoint 2 and nuanced clinical health information may further limit the generalizability of the data to the overall Wisconsin population and our ability to determine the reason for participants' visual impairment.

CONCLUSIONS

Vision impairment is associated with prevalent and incident poverty in this contemporary, representative Wisconsin population. Recognizing the health characteristics that increase poverty risk is essential for making systemic changes to address these disparities and creating a more equitable system. These findings support the need for and value of state and federal programs for individuals with visual impairment and suggest a need for employment support. Furthermore, expanding vision screening or recommending routine visual screening for adults may help identify visual impairment and connect individuals with ophthalmic care and social services. Further research is needed to characterize potential mediators and confounders in the association between vision impairment and poverty.

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