

Association between Vision Impairment and Physical Quality of Life Assessed Using National Surveillance Data

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SIGNIFICANCE: Physically unhealthy days assessments in national health surveillance datasets represent a useful metric for quantifying quality-of-life differences in those with and without vision impairment. Disproportionately poorer physical health in the visually impaired population provides further rationale for the inclusion of vision care in multidisciplinary approaches to chronic disease management.

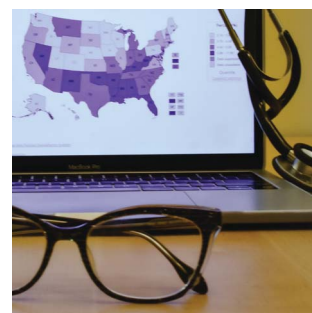
PURPOSE: This study aimed to assess the association between vision impairment and health-related quality of life using data from the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System.

METHODS: Data from each of the 50 states were extracted from the 2017 Behavioral Risk Factor Surveillance System data set. Self-report of difficulty seeing was used to categorize visually impaired versus nonvisually impaired populations. Self-report number of physically unhealthy days in the previous 30 days was used to quantify quality of life. The number of unhealthy days was calculated for the visually impaired and nonvisually impaired cohorts for each state. The ratio of the number of physically unhealthy days in the visually impaired versus nonvisually impaired population was calculated for each state and for different age cohorts.

RESULTS: Mean numbers of physically unhealthy days among persons with and without severe vision impairment across all states were 10.63 and 3.68 days, respectively, and demonstrated considerable geographic variability. Mean ratios of physically unhealthy healthy days in the visually impaired versus the nonvisually impaired population were 2.91 in the 18- to 39-year-old cohort, 2.87 in the 40- to 64-year-old cohort, and 2.16 in the ≥65-year-old cohort.

CONCLUSIONS: National surveillance data demonstrate a greater number of physically unhealthy days in the visually impaired population, indicating a need to improve our understanding of causes that lead to reduced physical health among those with vision impairment. Additional research is needed to better understand how individuals perceive vision as part of their overall health.

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As the ninth most common disability among adults in the United States,¹ vision impairment represents a considerable public health challenge² that is anticipated to worsen, largely because of projected aging changes in the population.^{3–5} Vision impairment is often managed as an isolated condition, even though the population with severe vision impairment experiences higher rates of other chronic conditions than their nonvisually impaired counterparts.^{6,7} These complex health dynamics result in lower health-related quality of life,^{8,9} including increased social isolation¹⁰ and increased mortality.¹¹

Currently, there is no systematic public health approach for vision impairment surveillance in the United States.¹² As a result, our understanding of many fundamental aspects underlying vision impairment, including core determinants and associated health outcomes, is limited. In addition, the few existing surveillance mechanisms that collect vision impairment data are often incompatible or nongeneralizable,¹³ further complicating our ability to quantify the burden of vision loss at the population level.

One national surveillance mechanism used to collect data on vision impairment in the United States is the Behavioral Risk Factor

Surveillance System. The Behavioral Risk Factor Surveillance System is a health-related telephone survey collecting state-level data about U.S. residents regarding their health-related risk behaviors, the use of preventive services, and chronic health conditions, including vision impairment. As the largest continuously conducted health survey in the world, the Behavioral Risk Factor Surveillance System collects data in all 50 states, as well as the District of Columbia and 3 U.S. territories, completing more than 400,000 adult interviews each year. Vision impairment is addressed in the core survey questionnaire through one question, “Are you blind or do you have serious difficulty seeing, even when wearing glasses?” Although this is only one question and is limited by its self-report nature, it is considered a validated method to estimate the prevalence of vision impairment for population health purposes.¹³

Several health-related quality-of-life domains are also assessed in the core Behavioral Risk Factor Surveillance System using a series of questions comprising the Healthy Days Section. Included among these questions is one addressing physical health, “Now thinking about your physical health, which includes physical illness and

injury, for how many days during the past 30 days was your physical health not good?" The high prevalence of chronic conditions in the population with vision impairment would suggest that individuals who experience vision impairment also experience physical limitations that impact their work or activities of daily living, resulting in a higher number of physically unhealthy days. This is consistent with an extensive body of literature demonstrating the impact of vision impairment on health-related quality of life¹⁴ and vision-related quality of life.^{15,16} Both health-related and vision-related quality of life are complex constructs that likely assess different domains, and studies clearly demonstrate that vision impairment has an influence on each, from smaller geographically specific cohorts^{17–19} to nationally representative samples.²⁰ These two quality-of-life constructs should not be considered interchangeable,²¹ however, and have been shown to be poorly correlated.¹⁴

Combining the vision impairment and quality-of-life responses from the same standardized, population-based surveillance mechanism has the potential to provide unique insight into differences between physical quality-of-life metrics in those with severe vision impairment versus those without vision impairment. The Behavioral Risk Factor Surveillance System has been used previously to quantify associations between vision impairment and multiple quality-of-life metrics using data from a subset of states that elected to add additional optional vision-related questions for respondents 40 years and older. Findings from these analyses demonstrated that quality of life in the population with vision impairment was reduced in those 65 years and older⁸ and those 40 to 64 years of age.⁹ These previous analyses were constrained by the fact that only 22 states implemented the optional Behavioral Risk Factor Surveillance System Vision Module, and no data were available for those younger than 40 years. In this study, we expand previous analyses by using data from the 2017 Behavioral Risk Factor Surveillance System, assessing differences in physically unhealthy days between visually impaired and nonvisually impaired cohorts in all 50 states. We further stratified respondents by age to assess any differences between younger, middle-aged, and older cohorts.

METHODS

The Behavioral Risk Factor Surveillance System is a state-based cross-sectional survey that collects data through continuous, random digit-dialed telephone surveys of noninstitutionalized U.S. civilians 18 years and older, administered by states and territories in collaboration with the Centers for Disease Control and Prevention (CDC). Survey participants are selected through a multistage cluster-design procedure, and the Behavioral Risk Factor Surveillance System contains de-identified, publicly available data, exempt from institutional review board approval. Details regarding the survey methods, questionnaires, data, and reports can be found at <https://www.cdc.gov/brfss/about/index.htm>.

Data from the 2017 administration of the Behavioral Risk Factor Surveillance System were evaluated for severe vision impairment and physically unhealthy days as individual outcomes, as well as the number of physically unhealthy days in those reporting vision impairment versus those who did not report vision impairment. The Behavioral Risk Factor Surveillance System includes one question in the core module assessing vision loss, "Are you blind or do you have serious difficulty seeing, even when wearing glasses?" Those who responded affirmatively were considered to have severe vision impairment, an accepted case definition used in population health

research for vision.¹³ The Behavioral Risk Factor Surveillance System includes one question in the core module assessing physically unhealthy days, "Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?" Persons who reported "do not know/not sure" or "refused" to either of these questions were excluded from the analysis.

Respondents were subdivided into three age categories: 18 to 39, 40 to 64, and ≥ 65 years, providing a younger, middle, and older cohort to examine age as a contributing factor. Age categories were selected for consistency with previous studies.^{8,9} SUDAAN statistical software, version 11.0.1 (RTI International, Research Park Triangle, NC), was used for the analysis to account for the complex sampling design. The overall prevalence of vision impairment and average number of physically unhealthy days were determined for each state. The average number of physically unhealthy days in the population with severe vision impairment was compared with the number of physically unhealthy days in the population without severe vision impairment using *t* tests. To assess the magnitude of any potential differences, the number of physically unhealthy days was compared among people with and without severe vision impairment using relative risk ratios for each of the three age categories for each of the 50 states. The median-weighted response rate for the 2017 Behavioral Risk Factor Surveillance System was 45.9%, and the study sample included 412,685 adults 18 years and older from the 50 states.

RESULTS

Table 1 illustrates the population demographics for the 2017 Behavioral Risk Factor Surveillance System. In summary, 55.6% respondents were women, 7.5% were non-Hispanic Black, and 7.2% were Hispanic. Of the respondents, 22.4% were 18 to 39 years old, 42.5% were 40 to 64 years old, and 35.1% were ≥ 65 years old.

Table 2 illustrates the prevalence of vision impairment separated by demographic categories. In summary, 4.4% of men and 5.3% of women reported severe vision impairment. Vision impairment increased with increasing age. The prevalence of severe vision impairment in the 18- to 39-year-old cohort was 2.6%, followed by 5.2% in the 40- to 64-year-old cohort and 6.0% in the ≥ 65 -year-old cohort.

Appendix Table A1, available at <http://links.lww.com/OPX/A523>, illustrates the overall prevalence of severe vision impairment and number of physically unhealthy days in each of the 50 states, as well as the number of physically unhealthy days among people with and without severe vision impairment. In 2017, the overall mean crude prevalence of severe vision impairment was 4.70% (95% confidence interval, 4.56 to 4.84%) and varied across the 50 states, ranging from 2.22% (95% confidence interval, 1.53 to 3.20%) in Alaska to 8.32% (95% confidence interval, 7.50 to 9.22%) in West Virginia. Similarly, the number of physically unhealthy days differed geographically. The overall mean number of physically unhealthy days across all states was 4.01 (95% confidence interval, 3.96 to 4.06), ranging from 3.09 (95% confidence interval, 2.95 to 3.23) in Minnesota to 5.74 (95% confidence interval, 5.42 to 6.05) in West Virginia. The overall mean number of physically unhealthy days among persons without severe vision impairment across all states was 3.68 (95% confidence interval, 3.63 to 3.73), ranging from 2.93 (95% confidence interval, 2.79 to 3.07) in Minnesota to 5.06 (95% confidence interval, 4.74 to 5.37) in West Virginia. The mean number of physically

TABLE 1. Population demographic characteristics of the 2017 administration of the Behavioral Risk Factor Surveillance Systems

Variable	Overall percentage	Visually impaired percentage	Not visually impaired percentage
Sex			
Male	44.4	39.9	44.6
Female	55.6	60.1	55.4
Missing	0.0	0.1	0.0
Age category (y)			
18–39	22.4	12.0	22.9
40–64	42.5	44.7	42.4
≥65	35.1	43.3	34.7
Race/ethnicity			
Non-Hispanic White	78.5	68.7	79.0
Non-Hispanic Black	7.5	11.7	7.3
Non-Hispanic Asian	2.1	1.2	2.2
Non-Hispanic American Indian/Alaskan Native	1.9	3.7	1.8
Hispanic	7.2	10.5	7.1
Non-Hispanic other	2.8	4.2	2.7

unhealthy days among persons with severe vision impairment was 10.63 (95% confidence interval, 10.27 to 11.00), ranging from 7.53 (95% confidence interval, 5.06 to 10.00) in South Dakota to 13.25 (95% confidence interval, 11.85 to 14.64) in West Virginia. The number of physically unhealthy days among all adults was higher among those with severe vision impairment compared with persons without severe vision impairment (*t* test, *P* < .001). The mean ratio of physically unhealthy days in adults with severe vision impairment versus those without severe vision impairment was 2.89, ranging from 2.14 in South Dakota to 3.89 in Maryland.

The frequencies of unhealthy days in the population with severe vision impairment versus the population without severe vision impairment separated by age groups are summarized in Table 3. The states with the highest and lowest prevalence rates of vision impairment are included in the table. Data for each of the 50 states are included in Appendix Table A2, available at <http://links.lww.com/OPX/A524>.

Age 18 to 39 Years

The overall mean prevalence of vision impairment across all states in the 18- to 39-year-old cohort was 2.79% (95% confidence interval, 2.59 to 3.01), and the mean number of physically unhealthy days was 2.53 (95% confidence interval, 2.46 to 2.61). The mean number of physically unhealthy days among persons without severe vision impairment in the 18- to 39-year-old cohort was 2.41 (95% confidence interval, 2.34 to 2.47), whereas the mean number of physically unhealthy days among persons with severe vision impairment in this cohort was 7.01 (95% confidence interval, 6.25 to 7.77). The number of physically unhealthy days was higher

among those with severe vision impairment compared with persons without severe vision impairment in the 18- to 39-year-old cohort (*t* test, *P* < .001). The mean ratio of physically unhealthy days in those with severe vision impairment versus those without severe vision impairment in the 18- to 39-year-old cohort was 2.91, ranging from 0.23 in Iowa to 5.36 in South Carolina (shown in Appendix Table A2, available at <http://links.lww.com/OPX/A524>).

Age 40 to 64 Years

The overall mean prevalence of vision impairment across all states in the 40- to 64-year-old cohort was 5.54% (95% confidence interval, 5.30 to 5.78%), and the mean number of physically unhealthy days was 4.74 (95% confidence interval, 4.65 to 4.83). The mean number of physically unhealthy days among persons without severe vision impairment in the 40- to 64-year-old cohort was 4.29 (95% confidence interval, 4.20 to 4.38), whereas the mean number of physically unhealthy days among persons with severe vision impairment in this cohort was 12.34 (95% confidence interval, 11.82 to 12.86). The number of physically unhealthy days was higher among those with severe vision impairment compared with persons without severe vision impairment in the 40- to 64-year-old cohort (*t* test, *P* < .001). The mean ratio of physically unhealthy days in those with severe vision impairment versus those without severe vision impairment in the 40- to 64-year-old cohort was 2.87, ranging from 2.18 in New Mexico to 4.39 in Nebraska and Virginia (shown in Appendix Table A2, available at <http://links.lww.com/OPX/A524>).

Age ≥65 Years

The overall mean prevalence of vision impairment across all states in the ≥65-year-old cohort was 6.60% (95% confidence interval, 6.28 to 6.93%), and the mean number of physically unhealthy days was 5.31 (95% confidence interval, 5.19 to 5.44). The mean

TABLE 2. The prevalence of severe vision impairment and those reporting no vision impairment stratified by demographic categories

Demographic category	Percentage reporting vision impairment	Percentage reporting no vision impairment
Sex		
Male	4.4	95.6
Female	5.3	94.7
Missing	6.1	93.9
Age category (y)		
18–39	2.6	97.4
40–64	5.2	94.9
≥65	6.0	94.0
Race/ethnicity		
Non-Hispanic White	4.3	95.7
Non-Hispanic Black	7.7	92.3
Non-Hispanic Asian	2.8	97.2
Non-Hispanic American Indian/Alaskan Native	9.6	90.4
Hispanic	7.1	92.9
Non-Hispanic other	7.4	92.6

TABLE 3. VI prevalence and mean unhealthy days stratified by age category and separated by states with highest and lowest VI prevalences

Age group (y)	Visually impaired % (95% CI)	Mean unhealthy days (95% CI)	Mean unhealthy days VI (95% CI)	Mean unhealthy days no VI (95% CI)	Ratio of physically unhealthy days in VI vs. no VI
18–39	2.79 (2.59–3.01)	2.53 (2.46–2.61)	7.01 (6.25–7.77)	2.41 (2.34–2.47)	2.91
40–64	5.54 (5.30–5.78)	4.74 (4.65–4.83)	12.34 (11.82–12.86)	4.29 (4.20–4.38)	2.87
≥65	6.60 (6.28–6.93)	5.31 (5.19–5.44)	10.64 (10.00–11.29)	4.94 (4.81–5.06)	2.16
States with the highest visually impaired prevalence by age group					
Arkansas 18–39	5.50 (3.41–8.75)	3.77 (2.91–4.64)	13.53 (6.30–20.76)	3.20 (2.47–3.94)	4.22
West Virginia 40–64	10.06 (8.76–11.52)	7.11 (6.60–7.62)	15.14 (13.24–17.04)	6.21 (5.70–6.72)	2.44
West Virginia ≥65	11.45 (9.88–13.22)	6.83 (6.25–7.41)	12.66 (10.64–14.68)	6.08 (5.49–6.67)	2.08
States with the lowest visually impaired prevalence by age group					
Alaska 18–39	0.67 (0.13–3.40)	2.40 (1.87–2.93)	0.75*	2.41 (1.88–2.95)	0.31
Wisconsin 40–64	2.66 (1.89–3.72)	4.34 (3.85–4.84)	13.29 (8.77–17.81)	4.10 (3.61–4.59)	3.24
Wisconsin ≥65	3.23 (2.24–4.64)	5.31 (4.67–5.96)	10.20 (5.75–14.66)	5.15 (4.50–5.80)	1.98

*Indicates insufficient sample size to determine confidence intervals. CI = confidence interval; VI = vision impairment.

number of physically unhealthy days among persons without severe vision impairment in the ≥65-year-old cohort was 4.94 (95% confidence interval, 4.81 to 5.06), whereas the mean number of physically unhealthy days among persons with severe vision impairment in this cohort was 10.64 (95% confidence interval, 10.00 to 11.29). The number of physically unhealthy days was higher among those with severe vision impairment compared with persons without severe vision impairment in the ≥65-year-old cohort (*t* test, *P* < .001). The mean ratio of physically unhealthy days in those with severe vision impairment versus those without severe vision impairment in the ≥65-year-old cohort was 2.16, ranging from 1.51 in Alaska to 2.81 in Connecticut (shown in Appendix Table A2, available at <http://links.lww.com/OPX/A524>).

DISCUSSION

There is broad recognition that vision impairment significantly impacts health-related quality of life,²² but the influence of vision impairment is difficult to quantify, as health-related quality of life is a complex, multidimensional construct with outcome metrics that are not typically captured in the course of clinical care.²³ In a 2002 review, Margolis et al.¹⁴ identified 22 vision-specific instruments, noting that “HR-QOL is a multidimensional construct that is defined as a person’s subjective perception of the impact of health status, including disease and treatment on physical, psychological, and social well-being. Very few of the instruments reviewed specifically assess health-related quality of life *per se* but rather visual function ability and the impact of vision impairment on daily lives.” Lamoureux and Pesudovs¹⁶ more recently emphasized the confusion created by multiple instruments assessing differing dimensions of quality of life—including function, emotional well-being, and social relationships—each having differing psychometric properties. These complexities are echoed by Renaud and Bédard,²⁴ who noted that “Despite its popularity, there is still no consensus about the conceptualization of QOL, apart from an agreement that it is multidimensional, personal, should primarily be evaluated subjectively, and can vary over time.”

In the current study, we used the CDC’s health-related quality-of-life questions, which are recognized as a “health-oriented subset of overall quality of life, which includes aspects of life satisfaction and happiness.”²⁵ The investigators who developed the Healthy Days inventory assert that “health-related quality of life includes domains of life (e.g., disability, perceived feelings and emotions, social engagement, pain, and fatigue) directly influenced by changes in health.”²⁶ An advantage of using the Behavioral Risk Factor Surveillance System for vision impairment analyses is that it is a well-established population health surveillance mechanism and provides a unique opportunity to investigate important associations between vision impairment and multiple health-related quality-of-life domains. In this study, we assess differences in physical health-related quality of life between the population with severe vision impairment and the population without vision impairment, finding that physical health was uniformly worse in the visually impaired cohort in all 50 states in the oldest 2 cohorts and in 48 of the 50 states in the youngest cohort.

In the current study, we found an overall national vision impairment prevalence rate of 4.70%. This estimate is within the range of other studies that have used national health surveillance data. Recently, Rein et al.²⁷ investigated vision impairment prevalence rates using five national health surveillance datasets, finding that national self-report vision impairment prevalence estimates ranged from 1.6 to 24.8% for those younger than 65 years and between 2.2 and 26.6% for those 65 years or older. The national estimate for vision impairment through physical examination data was 7.2%. Variability across these prevalence rates was attributed to sampling differences and response differences to survey questions, which varied considerably, even among questions with similar wording. Data modeling by Rein et al.²⁷ combined results from the five surveillance mechanisms to derive single weighted estimates. This weighting produced prevalence rates for any vision impairment of 7.7% nationally for self-report measures and 7.2% for examination-based measures for those 0 to 100 years of age in the United States. A study by Chan et al.⁵ that used clinical measures from the National Health and Nutrition Examination Survey estimated the low vision prevalence rate, defined as a best-corrected visual acuity of less than 20/40, to be 3% nationally in 2017 for adults 45 years and older. Extrapolating from these data, Chan et al.⁵ estimated that vision impairment

would increase significantly by 2050 and that a significant proportion of individuals across all age categories with presenting low vision could be corrected to 20/40 or better acuity.

Consistent with previous findings, we found considerable geographic variability in the distribution of vision impairment and associated health outcomes.^{8,9,23,28} When stratified by age, we found that the mean ratio of physically unhealthy days in the population with severe vision impairment versus those without severe vision impairment did not differ widely and that the mean ratio of unhealthy days was highest in the youngest cohort, those aged 18 to 39 years. This finding indicates that vision impairment is associated with poor physical health across the life spectrum; does not disproportionately impact the older population cohort, as we had anticipated; and has a significant impact on working-age adults.

Because vision impairment does not typically result in physical pain, physically unhealthy days represents a useful surrogate to characterize the overall health of the population with severe vision impairment, demonstrating that there are considerable health care needs in that community. Identifying these important health linkages provides evidence that supports the incorporation of vision care into multidisciplinary approaches to chronic disease management. Previous studies using National Health Interview Survey data find higher rates chronic conditions among older individuals with vision impairment.^{6,7} These comorbidities undoubtedly contribute to the increased number of physically unhealthy days in the population with severe vision impairment found in the current study. Insurance-based studies demonstrate that vision care providers are effective in early identification of several chronic diseases processes²⁹ and are effective at reestablishing ongoing care for patients who experience lapses in their chronic disease management.³⁰ The number of individuals with chronic conditions and multiple chronic conditions is projected to increase in the foreseeable future,³¹ necessitating more effective coordinated chronic disease management. The current study shows that the population with severe vision impairment is vulnerable to poor health outcomes in instances where eye care services could play an important role in improving care coordination, potentially reducing the number of physically unhealthy days in those with and without vision impairment.

Although the Behavioral Risk Factor Surveillance System has been used previously to assess health-related quality-of-life outcomes in populations with vision impairment, our analysis differs from previous work in several important ways. Crews et al.^{8,9} used physically unhealthy days as part of a composite health-related quality-of-life metric to compare visually impaired and nonvisually impaired cohorts, but the analysis could only be completed in the subset of 22 states that implemented the optional Behavioral Risk Factor Surveillance System Vision Module during the time it was supported by the CDC. In past analyses, unhealthy physical days responses were collapsed into binary categories (<15 or ≥15 days) and combined with other health-related quality-of-life outcome metrics to assess whether unhealthy days were generally greater in the populations experiencing vision impairment. This metric was not used to quantify the magnitude of differences between the populations with and without vision impairment. By normalizing the number of physically unhealthy days in the population with severe vision impairment by the number of unhealthy days in the population without severe vision impairment, we found that those with vision impairment experience as many as five times more physically unhealthy days than their nonvisually impaired counterparts. Because the optional Vision Module was only administered to individuals 40 years and older, Behavioral Risk Factor Surveillance

System health-related quality-of-life metrics have only been reported for cohorts 65 years and older⁸ and those 40 to 64 years of age.⁹ By broadening our analysis to include a younger cohort, we address an important recommendation outlined in the National Academies of Science, Engineering and Medicine report, highlighting the need for improved vision health surveillance in those younger than 40 years.³²

Using Behavioral Risk Factor Surveillance System data, we were able to show important health-related quality-of-life differences between the population with vision impairment and the population without vision impairment; however, the methodology used for this study is subject to several limitations. The data used for this analysis are self-report and cross-sectional. As a result, we cannot determine any temporal association between severe vision impairment and compromised physical health. The Behavioral Risk Factor Surveillance System item on physical health is also nonspecific and includes both physical illness and injury. It is unknown if participants considered their visual impairment to be a physical illness or had any symptoms related to their ocular condition, including eye pain. An inherent limitation of this survey is that we do not know if participants endorsed poor physical health because of the following: (1) their eye disease, (2) a systemic disease with ocular manifestations or visual sequela, (3) injury related to vision loss (falls, bumps), and/or (4) whether the reduced physical health was due to an unrelated, nonocular condition.

It is possible that vision impairment is the result of chronic health conditions that lead to more physically unhealthy days. For example, the leading cause of permanent vision loss in the working-age population in the United States is diabetes, a chronic condition that can result in an individual becoming visually impaired. Alternatively, vision impairment may be the underlying cause of compromised physical health, resulting in a greater number of physically unhealthy days. This is potentially the case in fall-related injuries, as the population with vision impairment has a higher predisposition for falls that can lead to longstanding physical injury.³³ The Behavioral Risk Factor Surveillance System does not allow us to determine the underlying cause of vision loss among respondents, which may influence the functional consequences associated with vision impairment. For example, the more common peripheral vision loss experienced in glaucoma may result in different functional limitations than central vision loss more commonly associated with age-related macular degeneration or diabetic eye disease. Quantifying the quality-of-life impact attributable to vision loss is challenging and further complicated by the fact that some individuals may differentiate vision health and overall well-being. This is highlighted by the fact that disability weights for blindness that are used to calculate disability adjusted life years have been shown to vary by a factor of 3 among international studies.³⁴ Many may consider vision impairment and general well-being to be independent, instead of interconnected. As a result, many individuals could simultaneously consider their vision to be poor but overall health to be good. This is consistent with the poor correlations that can be found between vision-related quality-of-life and health-related quality-of-life metrics.¹⁴ Sampling bias may also limit the generalizability of our results, as the Behavioral Risk Factor Surveillance System does not collect data on institutionalized individuals and as a result is not representative of segments of the population where physical chronic disease may be more prevalent.

Although the current study shows consistent differences between the population with vision impairment and the population that is not visually impaired, additional work is needed to provide

context to these findings. Ongoing collaborative work using Behavioral Risk Factor Surveillance System data demonstrate higher rates of chronic conditions and higher rates of poor health outcomes in those reporting vision impairment. These findings have been incorporated into educational materials intended to engage a wide range of vision health stakeholders.³⁵ A recently released vision health toolkit, developed by the CDC and the National Association of Chronic Disease Directors, highlights these analyses as actionable steps toward building vision health capacity among public health agencies and their partners.³⁶ Further effort is

needed to assess more upstream causes of physically unhealthy days in the population with vision impairment. This includes further analysis of population health data to identify specific comorbid dyads that result in the highest rates of compromised physical health to develop more precise, targeted interventions. Longitudinal analyses could be used to assess the impact of state-specific interventions, and additional health-related quality-of-life metrics, such as mentally unhealthy days, should be similarly assessed to quantify the impact of vision impairment across multiple health-related quality-of-life domains.

ARTICLE INFORMATION

Supplemental Digital Content: Appendix Table A1, available at <http://links.lww.com/OPX/A523>: overall prevalence of severe vision impairment and number of physically unhealthy days in each of the 50 states, as well as the number of physically unhealthy days among people with and without severe vision impairment. The number of physically unhealthy days was higher in the visually impaired cohort compared with the nonvisually impaired cohort ($P < .001$).

Appendix Table A2, available at <http://links.lww.com/OPX/A524>: the frequency of unhealthy days in the population that has severe vision impairment versus the population without severe vision impairment separated by age categories in each state. The number of physically unhealthy days was higher in the visually impaired cohort compared with the nonvisually impaired cohort in each of the three age categories ($P < .001$ for each age category). The mean ratio of physically unhealthy days in those with severe vision impairment versus those without severe vision impairment was 2.91 in the 18- to 39-year-old cohort, 2.87 in the 40- to 64-year-old cohort, and 2.16 in the ≥ 65 -year-old cohort. “+” for mean unhealthy days in the severe visually impaired 18- to 39-year-old cohort in Alaska indicates insufficient sample size to determine confidence intervals.

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