Vision Impairment and Blindness in the U.S.: New National, State, and County-level Prevalence Data

Elizabeth Lundeen, PhD, MPH
Vision Health Initiative, U.S. Centers for Disease Control and Prevention

David B. Rein, PhD, MPA
NORC at the University of Chicago
CDC’s Vision Health Initiative: Current and Future Priorities

Elizabeth Lundeen, PhD, MPH
The Vision Health Initiative (VHI) began in 2002

Located in CDC’s Division of Diabetes Translation

Mission: to promote vision health and quality of life for all populations, throughout all life stages, by preventing and controlling eye disease, eye injury, and vision loss resulting in disability

Aim: to enhance surveillance and applied research that provides the basis for effective public health programs and policy decisions to reduce the burden of vision loss

https://www.cdc.gov/visionhealth/index.htm
VHI Timeline: Major Milestones

1991–1994
CDC’s Behavioral Risk Factor Surveillance System (BRFSS) diabetes module measured the utilization of yearly dilated eye examination

1995–1996
BRFSS diabetes module expanded to include questions about visual functioning and eye care among people with diabetes

2002
Vision Health Initiative formed after CDC convened a meeting of distinguished experts in vision and eye health

2003
Optional vision module implemented by BRFSS

2005
CDC received Congressional funding for the “Blindness and Vision Loss Prevention Program”

2005-2008
CDC funded and implemented NHANES ophthalmic component with digital fundus photos
VHI Timeline: Major Milestones

2012
CDC began funding programs to identify populations at high risk of glaucoma and provide early screening, detection, and intervention.

2015
CDC began a cooperative agreement with NORC to “Establish a Vision and Eye Health Surveillance System for the Nation”.

2016
NASEM report “Making Eye Health a Population Health Imperative” recommended CDC develop a US surveillance system for vision and eye health.

2018
Vision and Eye Health Surveillance System (VEHSS) launched.

2020
VEHSS won an award at the American Public Health Association Annual Meeting: The Vision Care Section Outstanding Scientific Paper/Project Award.
Promoting Health Equity and Reducing Health Disparities

Vision Health Initiative seeks to:
- Develop interventions that promote eye health and prevent vision loss and blindness in groups at high risk
- Reduce disparities in vision loss and eye disease

Since 2012, VHI has been providing funding through cooperative agreements to implement innovative strategies to identify and reach populations at the greatest risk of developing glaucoma by intervening with early screening, detection, and treatment in community-based settings.
Screening and Intervention for Glaucoma and eye Health through Telemedicine

https://sightstudies.org/
Columbia University (coordinating center)
- Reaching racial and ethnic minority groups at highest risk of glaucoma and vision impairment by implementing a community vision screening and follow-up intervention for people living in affordable housing in the New York City neighborhoods of Harlem and Washington Heights
- Using patient navigators to help patients get recommended follow-up eye care

University of Michigan
- Using a validated telemedicine approach to screen for glaucoma and other eye diseases among populations at high risk in community primary care clinics
- Implementing personalized counseling and education programs through an electronic platform to improve glaucoma follow-up care

University of Alabama at Birmingham
- Implementing a primary care-based glaucoma screening program in Federally Qualified Health Centers in rural communities
- Using portable device taken directly to patients to conduct optic nerve structure assessments
Collaborate with the National Association of Chronic Disease Directors (NACDD)

- Promote the dissemination of evidence-based vision health interventions
- Integrate vision health activities into broader public health strategies and interventions
- Fund eight state partners working to improve vision health equity in populations at higher risk of vision loss and least likely to have access to eye care
  - Providing access to vision screening in local health departments and community health clinics
  - Providing innovative telehealth services to people who are most likely to have health conditions such as diabetes that cause vision loss

SUPPORTING STATE AND COMMUNITY PARTNERS
Toolkit to help state, tribal, local, and territorial public health agencies and their partners:

- Assess the level of vision impairment in their communities
- Build effective partnerships
- Implement effective and sustainable interventions to improve vision and eye health
- Evaluate the impact of vision-related interventions

https://www.cdc.gov/visionhealth/programs/vision-toolkit.html
State profiles provide data to help states assess the level of vision impairment in their communities

https://www.cdc.gov/visionhealth/data/state-profiles/index.htm
Economic Burden of Vision Loss and Eye Diseases

- Estimates of economic burden of vision loss and eye diseases published in 2006*
  - Annual total financial burden of major adult visual disorders was $35.4 billion

- Economic toolkit to update these estimates
  - Update estimates and provide state-specific economic burden of vision loss and eye diseases
  - Online interactive data repository

- Two papers (under peer review):
  - Estimate the economic burden of vision loss in the U.S. nationally and by state
  - Estimate Medicare payments for diagnosed major eye disorders among fee-for-service beneficiaries in 2018

Assess the burden of vision loss and eye diseases nationally and by states and counties

Understand differences in vision loss and eye diseases by:
- Geography
- Age
- Sex
- Race/ethnicity
- Risk factors (diabetes)
Data:

- National surveys
  - NHANES
  - NHIS
  - ACS
  - BRFSS
  - NSCH

- Administrative claims
  - Medicare
  - Medicaid
  - Marketscan
  - VSP Global managed vision care

- Electronic health record (EHR) registry
  - IRIS® (Intelligent Research in Sight)

Summary:

- 10 datasets (survey, EHR, claims)
- Over 220 vision and eye health indicators
- National-, state-, and county-level estimates

https://www.cdc.gov/visionhealth/vehss/index.html
VEHSS TOPICS

- Eye health conditions
  - Self-reported
  - Measured
  - Claims-based diagnoses
- Visual function
  - Measured visual acuity
  - Self-reported visual function
- Service utilization
  - Eye exams
  - Medical treatments
  - Low vision services
  - Vision correction

Prevalence of Vision Loss by U.S. County
FUTURE VISION HEALTH INITIATIVE PRIORITIES
Advancing Science and Epidemiology

- Validation study with University of Washington to assess the degree of concordance between different VEHSS indicators
  - Self-reported survey questions
  - Claims
  - Electronic health records
  - Clinical chart abstraction (gold standard)

- Advanced statistical methods (Bayesian meta-analysis) to develop composite estimates of the prevalence of vision loss and blindness in the U.S.

**Prevalence of Visual Acuity Loss or Blindness in the US
A Bayesian Meta-analysis**

Abraham D. Flaxman, PhD; John S. Wittenborn, BS; Toshana Robalik, BS; Rohit Gulia, MS; Robert B. Gerzoff, MS; Elizabeth A. Lundeen, PhD, MPH; Jinan Saaddine, MD, MPH; David B. Rein, PhD, MPA; for the Vision and Eye Health Surveillance System study group

Geographic Disparities: County-Level Surveillance Data

- Composite estimates of vision loss and blindness
- Medicare claims
- American Community Survey
Support research and surveillance to better understand the social determinants of vision and eye health

Datasets:
- National Health Interview Survey
- American Community Survey
- Behavioral Risk Factor Surveillance System
- National Health and Nutrition Examination Survey

NHANES Retinal Fundus Photo Artificial Intelligence Project

  - Performing a validation study comparing retinal fundus photo grading for diabetic retinopathy performed by deep learning algorithms to the gold standard ophthalmologist grading
  - Evaluate the potential for using deep learning algorithms in future NHANES surveys to provide faster and less expensive grading of retinal photos
Support Future NHANES Ophthalmology Module

- National Health and Nutrition Examination Survey (NHANES) ophthalmology module (last implemented in 2005–2008)

- Only nationally-representative prevalence estimates using measured vision and eye health data:
  - Visual acuity
  - Eye diseases
    - Diabetic retinopathy
    - Glaucoma
    - Age-related macular degeneration

- Timing of future repeat to be determined
Thank You

CONTACT:
ELIZABETH LUNDEEN, PHD, MPH
ELUNDEEN@CDC.GOV

Centers for Disease Control and Prevention
National Center for Chronic Disease Prevention and Health Promotion
Division of Diabetes Translation

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.
Vision Impairment and Blindness in
the U.S.

New National, State, and County-level Prevalence Data
07.14.21 : Version 1.1
David B. Rein, Ph.D.

On Behalf of the Vision and Eye Health Surveillance
System Study Group
Agenda

01 Acknowledgements
02 Background & Objective
03 Data & Methodology
04 New Estimates
05 Conclusions & Extensions
Paper: Prevalence of Visual Acuity Loss or Blindness in the US: A Bayesian Meta-analysis ¹.

Abraham Flaxman, Toshana Robalik, Rohit Gulia

John Wittenborn, David Rein

Bob Gerzoff, Elizabeth Lundeen, Jinan Saaddine

Background
United States prevalence of uncorrectable visual impairment or blindness previously estimated at 4.2 million $^{2,3}$

Limitations of Previous Estimate

• By design, excluded persons younger than age 40

• Excluded institutionalized populations
  – Nursing homes and other long term care.
  – Prisons

• Population-based study data: 8 to 36 years old

• No direct measurements at the state level

Opportunities for new estimate

• New data sources and methods

• VEHSS platform for data dissemination

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Objective: Produce new estimates of visual acuity loss and blindness by age, sex, race/ethnicity, and US state.

Address limitations in existing estimates

- Utilize population-representative data sources.
- Update population-based study data.
- Include previously excluded population groups.
- Use empirical self-report measurements to estimate state variation and provide additional information for under-represented groups (children and the oldest old).
Data & Methodology
Data Sources

• Population-based studies:
  – Baltimore Pediatric Eye Disease Study (BPEDS), 2003-2007
  – The Chinese American Eye Study (CHES), 2010-2013
  – Los Angeles Latino Eye Study (LALES), 2000-2003
  – Multi-Ethnic Study of Atherosclerosis Cohort, 2000-2004

• National Health and Nutrition Examination Survey (NHANES), 1999-2008

• National Survey of Children’s Health (NSCH), 2016

• American Community Survey (ACS), 2017
High Level Methods

• Bayesian, Meta-regression
  – Statistical tool to estimate regression models using multiple data sources

• Intuition
  – NHANES is used as a the reference group. The total amount of vision loss or blindness is based on NHANES evaluations of best-corrected visual acuity in the better seeing eye.
    • Any visual impairment = 20/40 or worse in the better seeing eye
    • Blindness = subset of any visual impairment = 20/200 or worse in better seeing eye
  – Self-reported responses to “Are you blind, or do you have serious difficulty seeing even when wearing glasses?” were used to estimate relative variation
    • By state
    • Among groups not included in NHANES
      – Children younger than 12
      – Persons in long term care and prisons
      – The oldest old

• Accounted for missing data in NHANES, and used PBS data for additional evidence
New Estimates
<table>
<thead>
<tr>
<th>Prevalence of Visual Impairment or Blindness</th>
<th>Prevalence Rate Across All Ages</th>
<th>Prevalence of Blindness</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.08 mil</td>
<td>2.17%</td>
<td>1.08 mil</td>
</tr>
<tr>
<td>(95% UI, 6.32 - 7.89)</td>
<td>(95% UI, 1.94% - 2.42%)</td>
<td>(95% UI, 0.82 - 1.30)</td>
</tr>
<tr>
<td>Prevalence of Visual Impairment or Blindness ages 0 to 39</td>
<td></td>
<td>Prevalence Rate was Higher for Women than Men</td>
</tr>
<tr>
<td>1.62 mil</td>
<td>358,000</td>
<td>w. 2.52%</td>
</tr>
<tr>
<td>(95% UI, 1.32 – 1.92)</td>
<td>(95% UI, 263k – 472k)</td>
<td>m. 1.82%</td>
</tr>
</tbody>
</table>
Prevalence rates increased with age and varied by race/ethnicity (although uncertainty intervals by race/eth overlapped)
NEW ESTIMATES: PREVALENCE RATE BY STATE

Highest Prevalence
- WV 3.6%
- MS 3.3%
- DC 3.2%
- NM 3.0%
- AZ 3.0%

Lowest Prevalence
- ME 1.4%
- UT 1.4%
- IA 1.5%
- ND 1.6%
- AK 1.7%
Primary Limitations

• Missing data in NHANES
  – Approximately 12% of NHANES observations had missing autorefractor data
  – Accounting for missing data increased mean prevalence rate from 1.7% to 2.2%

• Older data
  – Newer waves of NHANES examination data would be very valuable

• Self-reported measurements used to estimate variation
  – Assumption is self-reports are strongly correlated with evaluated visual impairment
  – Forthcoming research supports this assumption, but self-reports are imperfect

• Potentially, the inclusion of additional data sources could improve these estimates
Conclusions & Extensions
Conclusions

• We estimated that 7.08 million people were living with vision impairment or blindness in the United States in 2017;
  – 5.46 million with visual impairment (20/40 to >20/200)
  – 1.62 million with U.S. defined blindness (20/200 or worse)

• Compared to earlier estimates, 68% higher overall
  – Proportion of all visual impairment or blindness that is blindness is lower

• Based on self-reported data, we estimated substantial and meaningful variation at the state level

• Moving forward, these methods can be used to update estimates of state variation and population, but new waves of NHANES-like evaluation-based measures of best-corrected visual acuity are badly needed
Visit the Vision and Eye Health Surveillance System (VEHSS)
Google: VEHSS CDC
Want to Learn How to Use VEHSS? Thursday, July 15, Session 3E

Moderated Discussion 3E

**Topic:** Vision and Eye Health Surveillance System: Using National, State, and County-level Prevalence Data

**Session Moderator:** Elizabeth Lundeen, PhD, MPH
Vision Health Initiative, U.S. Centers for Disease Control and Prevention

**John Wittenborn**
NORC at the University of Chicago

**Dean VanNasdale, OD, PhD, FAAO**
The Ohio State University College of Optometry

📅 2:40 pm - 3:26 pm

- **Session 4: Keynote Presentation:** The Role of Public Health in Advancing Eye Health
  
  **Ross C. Brownson, PhD**
  Lipstein Distinguished Professor of Public Health, Washington University in St. Louis

📅 3:25 pm - 3:30 pm

- **Closing Remarks**

  **Jeff Todd**
  President & CEO, Prevent Blindness
CONCLUSIONS AND EXTENSIONS: HELP SPREAD THE WORD

Materials for your next presentation.

https://preventblindness.org/prevalence-visual-acuity-loss-blindness-us

More females than males experience permanent vision loss.

Three females for every two males experiencing visual acuity loss or blindness.

There is a higher risk of visual acuity loss among Hispanic and Black individuals than among Whites.

Much of it may be preventable as it may largely be due to issues that include:

- smoking
- sun exposure
- chronic disease
- access to health care
- social determinants of health
- lack of policies to promote early detection of vision disorders

MORE THAN 1.6 MILLION PEOPLE with uncorrectable visual acuity loss and 141,000 PERSONS with blindness (13.09% of all persons who are blind) ARE UNDER THE AGE OF 40.

This is the first national estimate of permanent visual acuity loss for people younger than age 40.

20% of all individuals age 85 and older in the U.S. experience permanent vision loss.
Thank you.

David Rein
Direct, Public Health Analytics
Rein-david@norc.org

On behalf of the VEHSS Study Group