Prevalence of Major Eye Diseases Among US Civil War Veterans, 1890-1910

Frank A. Sloan, PhD; Daniel W. Belsky, BA; Idrissa A. Boly, MA

Objectives: To estimate the prevalence of major eye diseases and low vision or blindness in a national sample of male US Union Army veterans from 1890 to 1910 and to compare these prevalence rates with contemporary rates for the same diseases and visual status.

Design: Longitudinal histories of 16,022 white Union Army veterans receiving disability pensions from 1890 to 1910 were developed from pension board examination records. Prevalence rates of trachoma, corneal opacities, cataract, diseases of the retina and optic nerve, and low vision or blindness were calculated in 1895 and 1910. Changes in prevalence by age were examined.

Results: By 1910, 11.9% of veterans had low vision or were blind in both eyes. Prevalence of cataract increased with age, resulting in 13.1% of veterans having had cataract in one or both eyes. Rates of trachoma were 3.2% in 1895 and 4.8% in 1910. Rates of corneal opacity were 3.0% and 5.1%, respectively. Glaucoma was rarely diagnosed from 1890 to 1910, but diseases of the optic nerve were reported in 2.0% of veterans in 1895 and 3.6% in 1910.

Conclusions: This study documents substantial reductions in the prevalence of low vision or blindness and changes in the composition of eye diseases from an era in which there were few effective therapies for eye diseases to the present.

Arch Ophthalmol. 2008;126(2):246-250

The 20th century experienced great changes in the treatment of major eye diseases. However, longevity also increased substantially. The US population aged older than 65 years increased from 4.1% in 1900 to 12.4% in 2000, and eye disease prevalence often increases with age. Thus, though innovations in treatment should have decreased prevalence, increases in population age may have, at least in part, offset these decreases. Nationally representative historical data documenting trends in prevalence of major eye diseases and low vision and blindness across several decades have been lacking.

Recently, data from a federal program that began in 1862 and paid pensions to Union Army veterans of the US Civil War (1861-1865) became available in machine-readable form. To obtain a pension, veterans had to be examined by a 3-physician panel, which determined whether their illnesses or injuries qualified for compensation. Prior to 1890, only service-connected disabilities were compensated. In 1890, the program was amended to include compensation for non-service-related conditions, which led to a major increase in veterans having examinations to obtain pensions. In 1907, the program was further amended to include old age as an eligibility criterion. Although old age was not recognized by statute as a basis for receiving a pension until 1907, a minimum pension was granted to all those aged 65 years or older from 1890 to 1907, unless the veteran was unusually vigorous.

This was the first major national pension program in the United States to which a large portion of federal expenditures was allocated in the late 19th century. The program covered 85% of Union Army veterans who were alive in 1900 and more than 90% of veterans who were alive in 1910. Only Union Army veterans were eligible.

METHODS

The data were produced by the Center for Population Economics at the University of Chicago. A 1-stage cluster sample of 331 Union Army companies was randomly selected by the Center for Population Economics from more than 20,000 company records stored at the National Archives in Washington, DC. These companies yielded a sample of 39,616 veterans. The following 3 public data files were used: surgeons' certificates, military pension and medical records, and census records.

The surgeons' certificates data consist of medical records used by the US Bureau of Pensions to evaluate pension applications. Each record contains physical examination findings. Veterans could apply for a pension more than once (they could claim >1 disability at each applica-
The sample increased by 50% between 1890 and 1895 (Table 1), reflecting the increase in veterans obtaining examinations after the statutory change in pension law in 1890. In 1895, of the 12,144 veterans in the sample, 84.8% were aged younger than 65 years. By 1910, of the 7,782 remaining veterans in the sample, only 17.8% were aged younger than 65 years. Most veterans were aged 65 through 74 years in 1910 (66.2%).

Cataract was by far the most common of the study diseases, with prevalence ranging from 4.5% for those younger than 55 years to 15.6% for those aged 75 years or older in 1895 (Table 2). In 1910, prevalence of cataract among those aged 75 years and older had risen to 17.1%. For those aged 65 through 74 years, prevalence of cataract was 8.4% in 1895 and 13.0% in 1910. Corneal opacity affected 3.8% and 4.8% of this age group in 1895 and 1910, respectively. Prevalence of trachoma was similar; that for diseases of the retina and optic nerve was much lower, ranging from just under 1% to 2% in 1895.

Prevalence of diseases of the retina increased between 1895 and 1910, even on an age-adjusted basis, possibly reflecting better detection in the latter year. However, in data for either year, rates of documented retinal disease did not increase with age, as is now typical in elderly populations. Prevalence of disease of the optic nerve did not change appreciably between 1895 and 1910 on an age-adjusted basis, and the patterns of prevalence rates with respect to age are irregular in both years.

In 1895 and 1910, respectively, 7.1% and 11.9% of the white male veteran population had low vision or blindness. The prevalence of low vision/blindness increased substantially with age. In 1895, 6.0% of veterans younger than 55 years and 11.0% aged 75 years or older had this diagnosis. In 1910, 14.1% of veterans aged 75 years or older were recorded as having low vision or being blind in both eyes.

Of those veterans with low vision or blindness, most had diagnosed cataract (Table 3). Corneal opacity and trachoma were present in one-quarter or more of these individuals. Diseases of the retina and optic nerve were documented in 13% to 15% and 8% to 10% of these cases, respectively.

COMMENT

Several major eye diseases and low vision/blindness were highly prevalent at the turn of the 20th century. Prevalence of some major eye diseases, especially cataract, increased substantially with age.

Owing to increased longevity and improved medical knowledge and diagnostic techniques, reported prevalence increased for many eye diseases. Current rates of cataract surgery, a reasonable proxy for cataract prevalence in high-income countries, are well above those for cataract and cataract surgery combined in the Union Army data, especially for populations aged 70 years or older. Data from populations aged 65 years or older in the 1990s indicate a prevalence rate of about 5% for age-related macular degeneration, about 7% for diabetic retinopathy, and close to 8% for glaucoma. The combined rates of 5% and 7% for the retinal diseases are far above the corresponding rates in the Union Army data (considering joint prevalence of both diseases), even allowing for a somewhat higher mean age of the more recent population. Diabetes prevalence among white veterans in 1895 was about 2% and was about 4% in 1910. Judging from recent data, far fewer than half of veterans...
with diagnosed diabetes would have had retinal disease (<1% in 1895 and <2% in 1910). Urinalysis was used during this period to diagnose diabetes. Recent prevalence of glaucoma is also much higher than the rates diagnosed in the Union Army veteran population, even accounting for some differences in age between the comparison and Union Army data. However, trachoma, which was highly prevalent in the United States around 1900, is now virtually nonexistent in the developed world, which is largely a result of better sanitation, improved personal hygiene, and antibiotics. The disease now exists almost exclusively in low-income countries, where sanitation and hygiene may be more like that of the United States in the early 20th century. According to the World Health Organization, prevalence of blindness in Africa among individuals aged 50 years or older was 9% in 2002. In Southeast Asia, including Indonesia, Malaysia, the Philippines, and Thailand, prevalence in 2002 was 6.3%. Combined prevalence of blindness and low vision (best-corrected visual acuity 20/60 OU and 20/200 OU) among adults in Pakistan and Bangladesh is around 10%. Rates for persons aged 60 to 69 years have been reported at 13% in Malaysia and 8% in Nepal.

Access to affordable, safe, and effective cataract surgery is of primary importance in decreasing prevalence of blindness in the developed world. Cataract is the leading cause of blindness globally, accounting for 47.8% of adult-onset blindness. The EDPGR estimated that among white Americans, cataract caused less than 9% of blindness, even though the US population is proportionally much older than the world as a whole; 7.4% of the global population is aged 65 years or older compared with more than 12% of the US population.

Causes of low vision or blindness cannot be ascertained from the Union Army data; however, prevalence of eye diseases among those with low vision or blindness provide an approximation. These data assign a major role to cataract as causing low vision or blindness. Even with better technology, contemporary estimates of the causes of the 2 conditions in the United States differ appreciably. Access to affordable, safe, and effective cataract surgery is of primary importance in decreasing prevalence of blindness in the developed world. Cataract is the leading cause of blindness globally, accounting for 47.8% of adult-onset blindness. The EDPGR estimated that among white Americans, cataract caused less than 9% of blindness, even though the US population is proportionally much older than the world as a whole; 7.4% of the global population is aged 65 years or older compared with more than 12% of the US population.

In contrast to increases in reported prevalence of major eye diseases, visual outcomes in the United States have improved dramatically since about 1900. Data from the World Health Organization from 2002 indicate that blindness prevalence (defined as visual acuity < 20/400 OU) among those aged 50 years or older in the United States was 0.4%. The Eye Disease Prevalence Research Group (EDPRG) reported a combined prevalence of blindness (defined as best-corrected visual acuity < 20/200 OU) and low vision (defined as best-corrected visual acuity < 20/40 OU) for those aged 40 years or older of less than 3%. Rates for other high-income countries are similar.

Eye disease prevalence in the Union Army veterans data are more similar to reported prevalence in low-income countries, where sanitation and hygiene may be more like that of the United States in the early 20th century. According to the World Health Organization, prevalence of blindness in Africa among individuals aged 50 years or older was 9% in 2002. In Southeast Asia, including Indonesia, Malaysia, the Philippines, and Thailand, prevalence in 2002 was 6.3%. Combined prevalence of blindness and low vision (best-corrected visual acuity < 20/60 OU and > 20/200 OU) among adults in Pakistan and Bangladesh is around 10%. Rates for persons aged 60 to 69 years have been reported at 13% in Malaysia and 8% in Nepal.

Access to affordable, safe, and effective cataract surgery is of primary importance in decreasing prevalence of blindness in the developed world. Cataract is the leading cause of blindness globally, accounting for 47.8% of adult-onset blindness. The EDPGR estimated that among white Americans, cataract caused less than 9% of blindness, even though the US population is proportionally much older than the world as a whole; 7.4% of the global population is aged 65 years or older compared with more than 12% of the US population.

Causes of low vision or blindness cannot be ascertained from the Union Army data; however, prevalence of eye diseases among those with low vision or blindness provide an approximation. These data assign a major role to cataract as causing low vision or blindness. Even with better technology, contemporary estimates of the causes of the 2 conditions in the United States differ appreciably. Access to affordable, safe, and effective cataract surgery is of primary importance in decreasing prevalence of blindness in the developed world. Cataract is the leading cause of blindness globally, accounting for 47.8% of adult-onset blindness. The EDPGR estimated that among white Americans, cataract caused less than 9% of blindness, even though the US population is proportionally much older than the world as a whole; 7.4% of the global population is aged 65 years or older compared with more than 12% of the US population.

Causes of low vision or blindness cannot be ascertained from the Union Army data; however, prevalence of eye diseases among those with low vision or blindness provide an approximation. These data assign a major role to cataract as causing low vision or blindness. Even with better technology, contemporary estimates of the causes of the 2 conditions in the United States differ appreciably.

### Table 2. Prevalence of Major Eye Disease Among US Civil War Veterans in 1895 and 1910 by Age

<table>
<thead>
<tr>
<th>Disease</th>
<th>1895 (n=5753) (%)</th>
<th>1910 (n=1378) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 55 y</td>
<td>55-64 y</td>
<td>65-74 y</td>
</tr>
<tr>
<td>- Trachoma</td>
<td>2.2</td>
<td>3.7</td>
</tr>
<tr>
<td>- Corneal opacity</td>
<td>2.7</td>
<td>3.3</td>
</tr>
<tr>
<td>- Cataract</td>
<td>4.5</td>
<td>7.5</td>
</tr>
<tr>
<td>- Disease of retina</td>
<td>1.9</td>
<td>2.3</td>
</tr>
<tr>
<td>- Disease of optic nerve</td>
<td>0.8</td>
<td>1.2</td>
</tr>
<tr>
<td>- Low vision/blindness</td>
<td>6.0</td>
<td>8.0</td>
</tr>
</tbody>
</table>

*Seven persons had reported birthdates of 1856 or later. These birthdates are implausible; these persons were excluded from this table.*

### Table 3. Prevalence of Major Eye Diseases Among US Civil War Veterans With Low Vision/Blindness

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Veterans</th>
<th>Veterans With Low Vision/Blindness, %</th>
<th>Disease Prevalence in Veterans With Low Vision/Blindness, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trachoma</td>
</tr>
<tr>
<td>1890</td>
<td>8020</td>
<td>5.4</td>
<td>31.0</td>
</tr>
<tr>
<td>1891</td>
<td>8693</td>
<td>7.5</td>
<td>27.6</td>
</tr>
<tr>
<td>1895</td>
<td>12 144</td>
<td>7.1</td>
<td>23.8</td>
</tr>
<tr>
<td>1900</td>
<td>11 291</td>
<td>9.4</td>
<td>24.5</td>
</tr>
<tr>
<td>1905</td>
<td>9849</td>
<td>11.6</td>
<td>24.1</td>
</tr>
<tr>
<td>1910</td>
<td>7782</td>
<td>11.9</td>
<td>24.8</td>
</tr>
</tbody>
</table>

*Includes the 7 persons with birthdates of 1856 or later excluded from Table 2.*
cording to EDPGR’s meta-analysis, cataract, for example, accounts for 59.9% of low vision and only 8.7% of blindness among white Americans. Rates are 3.3% and 6.4% for glaucoma and 22.9% and 54.4% for age-related macular degeneration among white individuals with low vision and blindness, respectively.23 Age-related macular degeneration’s prominence in the EDPGR meta-analysis relative to that in the Union Army data (even considering that some diabetic retinopathy would have also been included in diseases of the retina) primarily reflects current knowledge compared with that of a century ago as well as the higher fraction of younger elderly in the veterans’ analysis.

Unlike cataract, age-related macular degeneration, and glaucoma, corneal opacities were much more common among those with low vision or blindness in the Union Army sample compared with contemporary populations in both the United States or low-income countries. Corneal opacities accounted for 3% of blindness in the United States and 8% to 12% of blindness in Africa in 2002.25 Higher prevalence of trachoma, the most important infectious cause of corneal opacity,19 cannot fully explain this effect. While rates of trachoma in Africa (6%-8%)25 are higher than those in our data, the reported effect of corneal opacity on vision is substantially lower. Corneal scarring from war-related trauma is the likeliest explanation for the high rates of corneal opacity among those with visual impairments in the veterans’ sample. This explanation is supported by the decline in the prevalence of corneal opacity among those with serious visual impairment as the sample aged and other eye diseases become more common.

A strength of the veterans data is that they are fairly representative of middle-aged and elderly white men who were alive around 1900. About half of adult white men in the North fought in the Civil War.35 Many men whose poor health precluded fighting in the Civil War, owing to, eg, congenital heart disease, probably did not survive to 1895.35 The pension program covered 85% of all Union Army veterans by 1900 and more than 90% by 1910.4,5 Because of the pension program, stated that “No pension is given for a partial loss of sight or for the partial or complete loss of the field of vision or the muscular functions of the eyes.” Graeff,37 writing more than 3 decades after Fuchs,38 Alt,39 and Higgens,40 characterized amblyopia as a historical scientific term for severe visual impairment. He argued that if the criterion of amaurosis had been strictly applied as a basis for admission, 80% to 90% of all residents of institutions for the blind would have been there inappropriately.

Glaucoma provides an example of the lack of understanding of disease processes in the early 20th century. The term glaucoma appeared in ophthalmologic reference books of the period, and it was one of the listed diagnoses the board of surgeons could apply following their examinations of pension applicants; but the consequences of glaucoma were not understood then. There are 2 chief reasons for the rarity of reported glaucoma: (1) The disease was thought to be very uncommon and (2) the relationship between glaucoma and the optic nerve was not well understood. Fuchs38 wrote in 1898 that glaucoma accounted for less than 1% of all eye diseases. In 1900, Deyl and Sattler’s42 chapter “Diseases of the Optic Nerve” in Norris and Oliver’s System of Diseases of the Eye made no reference to glaucoma, though some connection with the optic disc was mentioned in Smith’s43 chapter on glaucoma in the same volume. Fuchs38 identified excavation of the optic nerve as the cause of blindness in advanced glaucoma but went no further. Both Alt39 and Higgens40 discussed glaucoma and the optic nerve separately. However, by the time Graeff’s37 text was published in 1933, examination of the optic nerve was used to diagnose glaucoma. Although tonometers existed in the late 1800s,44 in our data, there were more findings of disease of the optic nerve than there were of diagnoses labeled glaucoma. Thus, in our analysis, the latter was combined with the former group.

This study documents substantial reductions in the prevalence of low vision/blindness and changes in the composition of eye diseases from an era in which there were few effective therapies for eye diseases to the present.
Comparisons of major eye diseases over the course of 100 years reveal substantial improvements in visual function. The appreciable reductions in the prevalence of low vision/blindness reflect such technological changes as innovations in the treatment of cataract and glaucoma and economic growth, which provided funds for developing capacity and financing provision of services. Other improvements, such as a reduction in the prevalence of trachoma, reflect improvements in environmental and public health, which is largely a byproduct of a country’s level of economic development.

The burden of chronic eye disease is substantial1-3 and is reflected by (1) the resources devoted to its diagnosis and treatment and (2) the losses in productivity and quality of life it can cause. Both are important components of the total burden. Around 1900, when therapeutic options were limited, the burden of such disease and disability was largely borne outside the health care system. But nevertheless, particularly as reflected in high rates of low vision/blindness, this burden was substantial and much greater than it is now.

Submitted for Publication: September 13, 2006; final revision received March 23, 2007; accepted March 27, 2007.

Correspondence: Frank A. Sloan, PhD, Center for Health Policy, 114 Rubenstein Hall, Box 90253, Duke University, Durham, NC 27708 (fsloan@hpolicy.duke.edu).

Financial Disclosure: None reported.

Funding/Support: This study was supported in part by grant R37-AI-17473-05A1 from the National Institute on Aging.

Role of the Sponsor: The sponsor had no role in the design or conduct of this study.

REFERENCES


©2008 American Medical Association. All rights reserved.