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Hearing Loss in Union Army Veterans from 1862 to 1920

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Objectives: **To examine the prevalence of hearing loss (HL) in Union Army (UA) veterans by year, birth cohort, and occupation, and to compare Civil War pension and contemporary disability programs by examining monthly dollar awards.** ***Study Design:*** **A retrospective review of medical records for 17,722 UA veteran pension applicants, a subset of some 35,000 soldiers retrieved randomly from the Military Archives.** ***Methods:*** **The diagnosis of HL was based on review of medical records, which used gross measurements because of the unavailability of audiometric testing.** ***Results:*** **One third (5,891 or 33%) of pensioners sampled received compensation for HL. The veterans with HL suffered predominantly from left-sided HL (4,091 or 70%), which is consistent with noise-induced HL in a right-handed individual firing a rifle. Comparison of civilian occupations reveals minimal variation in prevalence of HL. Civil War pensions for unilateral HL averaged $134.04 per year, representing nearly one third of the average annual income in 1890. Bilateral HL received nearly twice that amount. Today, military veterans receive $1,248 annually for unilateral loss and $27,288 annually for bilateral loss. Social Security disability benefits are granted only for bilateral HL, with an average 60-year-old individual receiving $11,400 per year.** ***Conclusion:*** **HL was a common disability among UA Civil War veterans, with noise exposure a likely etiology for the HL. The differing levels of compensation for HL may reflect differing perceptions on the incapacitating effects of HL.** ***Key Words:*** **History of hearing loss, public policy, disability, Civil War.**

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INTRODUCTION

Hearing loss represents an ongoing challenge to public health policy. It is a common impairment in the United States, affecting 20 million adults, with the attendant societal costs in the billions of dollars.[1,2] It impacts the quality of life of those affected, with studies indicating increased levels of depression and impaired activities of daily living.[3]

The challenges of hearing loss, however, are not unique to modern society. The first comprehensive effort in the United States to address the personal impact of hearing loss occurred through the pension system for Union Army (UA) veterans who fought in the Civil War between 1861–1865. Two major legislative acts composed the UA Civil War pension scheme. The first, the General Law of 1862, provided benefits to soldiers who were directly disabled by war injuries. This act was followed by the Disability Act of 1890, which ushered in a system of universal service pensions regardless of whether the disability originated from the war. Under both legislative systems, pension amounts increased as the disability impaired the veteran's ability to perform manual labor.

In this article, we examine the UA pensioners diagnosed with hearing loss, their work patterns, and the related origins of hearing loss public policy in late 19th century America. This historical period is significant as it coincided with the advent of industrialization and marked the rise of the American administrative state with its broadened conceptions of social insurance policy. Although ample research has been conducted on hearing loss using contemporary populations, there is less information on the prevalence and impact of hearing loss in late 19th century America.

MATERIALS AND METHODS

Data

This analysis is based on data developed by the Center for Population Economics at the University of Chicago as part of the Early Indicators of Later Work Levels, Disease, and Death (EI) project. A one-stage cluster sampling procedure was used to randomly select 35,747 white males in 303 UA companies from the over 20,000 company books stored at the National Archives in Washington, DC. The sample excludes commissioned officers, black recruits, and other military branches.[4] Preliminary re-

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TABLE I.
Number of Complaints That Led to Examinations Per Disease Group from 1862 to 1907.

Disease	Number of Complaints	As Percentage of Total Number of Complaints
Rheumatism/musculoskeletal	22,191	16.90
Injury/gunshot wound	21,455	16.34
Cardiovascular	15,271	11.63
Diarrhea	10,536	8.03
Respiratory	10,291	7.84
Rectum/hemorrhoids	10,030	7.64
Eye disorders	6,878	5.24
Hernia	6,466	4.93
General appearance	5,750	4.38
Ear diseases	4,770	3.63
Nervous system	3,868	2.95
Gastrointestinal	3,709	2.83
Varicose veins	3,097	2.36
Genito-urinary	2,888	2.20
Infectious diseases and fevers	1,875	1.43
Liver, spleen, and gallbladder	1,729	1.32
Neoplasm/tumor	358	0.27
Endocrine diseases	116	0.09
Total	131,278	100.00

search indicates that the sample is representative of the white male population who served in the UA.[5]

The project is comprised of three principal datasets. The first dataset, referred to as "Surgeon's Certificates," contains medical records used by the Bureau of Pensions to evaluate pension applications. The second dataset, called the "Military, Pension, and Medical Records," includes military records and pension applications. The final dataset, named the "Census Records," contains information from U.S. Federal Censuses. The information for each UA veteran is linked through these datasets by way of a unique identification number, which allows researchers to track the military, medical, and socioeconomic information for individual veterans.[4]

The Surgeon's Certificates dataset is based on physical examination records used to determine eligibility for federal pensions. In total, the sample includes 87,224 examinations on 17,721 pensioners. Because each applicant could have more than a single claimed disability, the total number of medical complaints contained in all 87,224 examinations amounts to 131,278.[4]

Definitions and Techniques

The medical information contained in the Surgeon's Certificates has been standardized using 21 health screens. Each screen includes a predetermined number of variables, resulting in a total of 3,516 individual variables. The health screens are based on organ systems (e.g., cardiovascular and respiratory) and specific disabling conditions as rated by physicians (e.g., diarrhea, hernias, and varicose veins).[4]

This study used information contained under the disease screen entitled "Ear Diseases" in the Surgeon's Certificates dataset. This screen selected certificates that mentioned hearing loss (HL), ear injuries, or ear disease. The selected certificate was then placed into 1 of 13 categories depending on the condition and disease described. The categories include hearing capability, ear infection description, eustachian tube blockage, tympanic membrane description, mastoid description, and other diseases related to the ear and HL. Only those categories that concerned HL were used in the analysis for this article.

For a given examination, we define the prevalence of HL to be any diagnosis that either stated "total deafness" or granted a monthly compensation award. We assumed that once a recruit was diagnosed with HL in an examination, the condition would remain for the rest of his life, even though subsequent examinations might not mention HL.

We also used pension compensation level as an indicator of disability severity. To allow for comparison of compensation levels across disability pension schemes, we have standardized the monetary awards based on the pension acts in effect in 1889 (i.e., roughly the mid-point in the pension scheme and immediately before the Disability Pension Law of 1890). The maximum monetary compensation available for ear disability in 1889 was $30 per month, with less severe hearing disability receiving a fraction of the maximum pension. For our purposes, fractional amounts resulting in payments of $10 or less each month have been labeled "minimal," over $10 but less than $20 as "modest," and over $20 as "extreme." These terms are descriptive and do not correlate to modern standards for degree of deafness.

UA recruits' demographic and socioeconomic backgrounds were obtained by linking the Surgeon's Certificates data with the Military Records, which provided information on birth and death dates, and occupation at enlistment. Occupations were classified according to Wilcox's[6] method. We created five separate occupational categories that correspond to socioeconomic status (SES). Ranking from lower to higher SES, they are 1) farm/manual laborers, 2) artisans, 3) semi-skilled workers, 4) farm owners, and 5) professionals.[7]

RESULTS

Between 1862 and 1907, pension applicants had a total of 131,278 complaints brought to the pension bureau (Table I). The leading veteran complaints included rheu-

TABLE II.
Hearing Loss Severity Ratings as Reflected in Pension Award Amounts Standardized to 1889 Legislative Scheme.

Severity Rating	Left Ear Percentage	Right Ear Percentage
Minimal (<$10/month)	60	66
Modest ($10–$20/month)	23	12
Extreme (>$20/month)	17	22

matism/musculoskeletal, injury/gunshot wound, and cardiovascular, comprising almost half (44.87%) of all complaints. Ear conditions were mentioned in 4,770, or 3.63%, of the total. This percentage does not translate into an ear-condition prevalence rate but rather indicates that 3.63% of self-reported complaints pertained to ear conditions.

The actual prevalence of HL among UA veterans was much higher than the number of complaints would indicate, with one third (5,891 or 33%) of pensioners sampled receiving compensation for HL. For those with HL, the majority had only left-sided loss (4,091 or 70%). Despite the large disparity in prevalence rates between the ears, the degree of the HL was consistent between right- and left-sided HL (Table II). Approximately 60% of those with left-sided HL had minimal HL, as compared with 66% for those with right-sided loss. Extreme HL was less common, with only 17% and 22% loss on the left and right sides, respectively.

Significant variation is observed when prevalence is examined by annual rate (Fig. 1). Immediately after the war, fewer than 5% received compensation. By 1907, the number of veterans receiving pensions for HL had increased to nearly 35% (Fig. 1). The most significant increase occurred in 1891, immediately after the passage of the 1890 Pension Act. The increase in prevalence coincided with an increase in HL examinations, with the largest increase in 1892 (Fig. 2).

When comparison is made by birth cohort, HL is noted to increase as the population aged (Fig. 3). Although all cohorts show an increase in prevalence with time, younger cohorts show a higher prevalence of HL at younger ages than do older cohorts. For example, at the age of 46 to 50, those born between 1840 and 1844 were three times more likely to report HL than those born between 1825 and 1829.

Comparison of enlistment occupations showed little variation in prevalence of HL (Fig. 4). In each occupational group, roughly 30% of recruits eventually suffered HL between 1862 and 1907. The amount of compensation, however, did show variation (Table III). After standardizing dollar amounts between differing legislative schemes, professionals received the highest average dollar ratings of $11.56. Artisans received slightly lower amounts, with ratings of $11.52. Laborers had ratings of $11.25. Farm

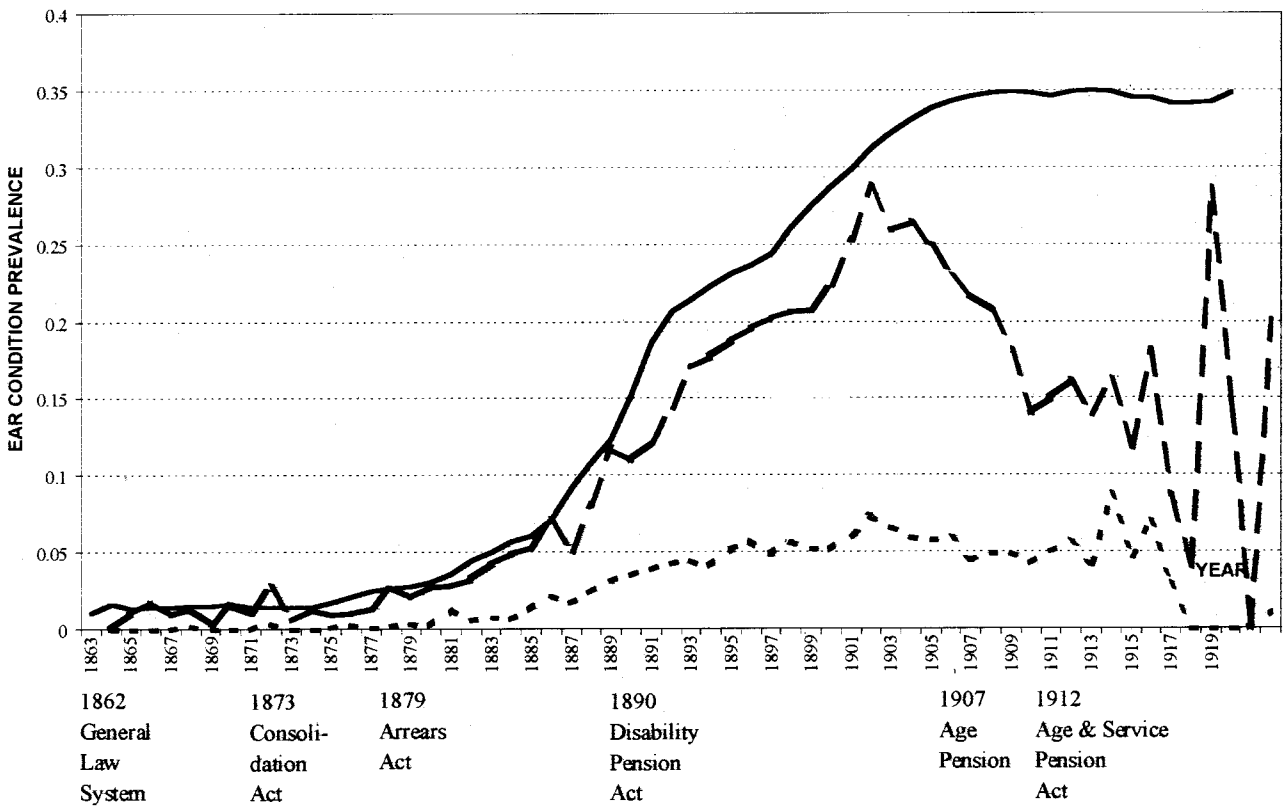

Fig. 1. Left or right ears (solid line); left ear (dashed line); right ear (dotted line). *Prevalence in a given year is defined as the number of veterans diagnosed with an ear condition divided by the total number of veterans examined in that year. Once diagnosed with an ear condition, that condition remained for the rest of the veteran's life. Base populations for the calculation of prevalence varied from year to year.

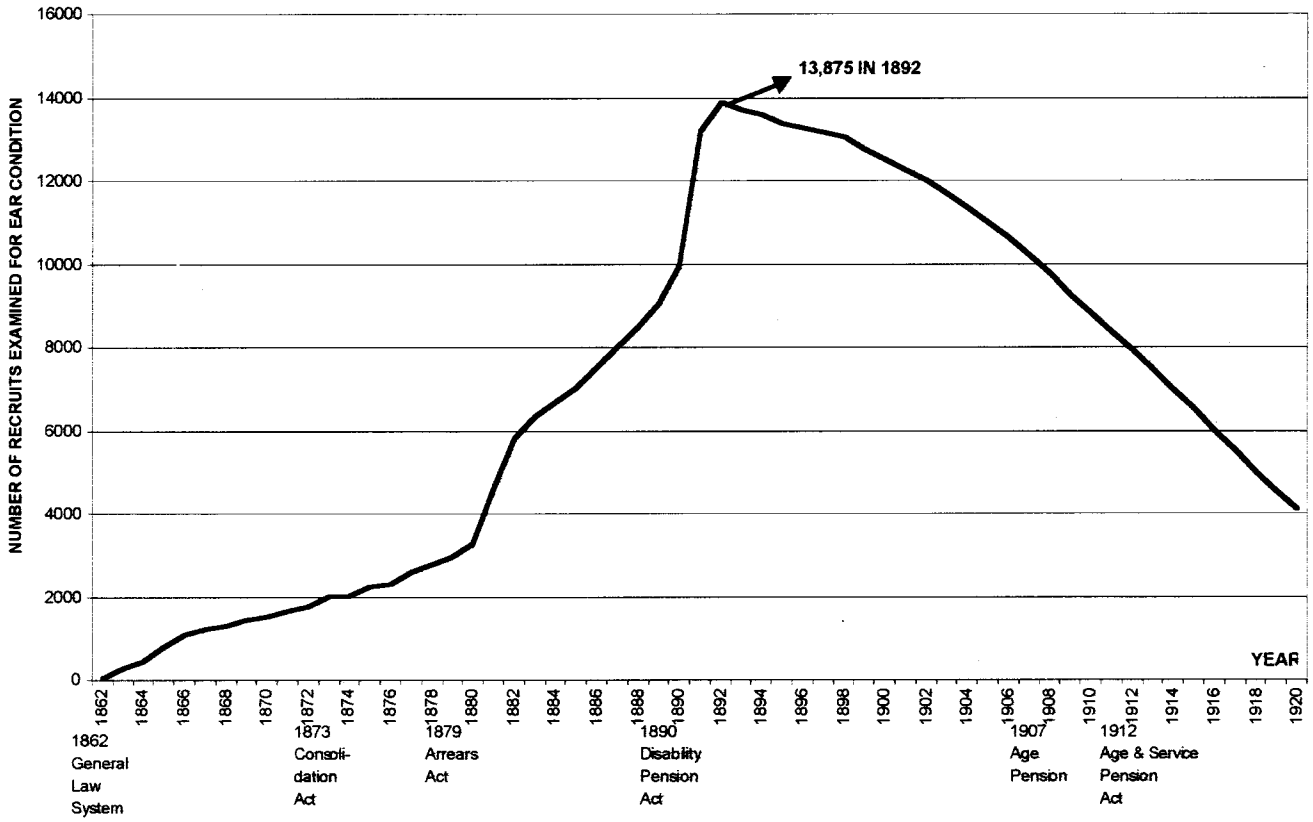

Fig. 2. *Recruits examined for conditions other than ear conditions are not included.

owners and semi-skilled workers received the lowest amounts, $10.93 and $9.04, respectively, for unilateral HL. With use of a t test to examine these later differences in dollar ratings, farm owners received substantially lower dollar amounts (*P* value significant at the 10% level), as did semi-skilled workers (*P* value at the 5% level). For recruits with bilateral HL, the dollar ratings were higher. Average ratings for bilateral HL were $19.67, nearly twice the average ratings for unilateral HL (Table III).

DISCUSSION

There are features of the UA dataset that make it particularly useful for historic policy analysis. First, the ability of veterans to apply for pensions over time and to request increases in pensions created a unique longitudinal dataset. Second, the UA dataset relies on more than self-assessed measures of health because a claimed disability required verification by a panel of three physicians. Finally, physician-verified impairments were given severity ratings, an advantage over zero-one dummy variables that provide prevalence information but offer no information regarding the severity of disability.

The UA dataset, however, does have limitations. First, the dataset includes only veterans who filed at least one disability pension claim. No medical records exist for those who were healthy or chose to not pursue disability claims. The denominator population, therefore, is not comprised of both healthy and impaired individuals. Rather, only those with HL or other impairments are included in the study. In addition, the study only includes enlisted white males. The degree of prevalence derived from the UA dataset therefore may overestimate the prevalence of the general population toward the end of the 19th century.

The second limitation of the dataset is that it is historic. The diagnostic methodology and terminology of late 19th century physicians do not correspond to modern standards. As audiometric testing was being developed, it was not clinically available. Tuning forks and Politzer's acoumeter were available but not mentioned in Pension Bureau guidelines. Rather, the diagnosis of HL was based on a speculum and ability to hear ordinary conversation from 6 feet, 3 feet, or 1 foot.[8] To possibly counter the subjective nature of the test, the disability diagnosis required three examining surgeons to agree on a final diagnosis.

The lack of modern testing methods may have resulted in an underestimation of the actual prevalence of HL in UA veterans. Modern epidemiologic studies using self-reporting find that nearly 27% of those over the age of 65 have HL. When audiometric testing is used, the prevalence of HL increases to nearly 46%.[9] The prevalence of HL among UA veterans was 33%, somewhat similar to the modern prevalence of self-reported HL. It is likely that audiometric testing would have resulted in a higher prevalence of HL.

Comparing the number of complaints, examinations, and pensions for HL illustrates the difficulty in identify-

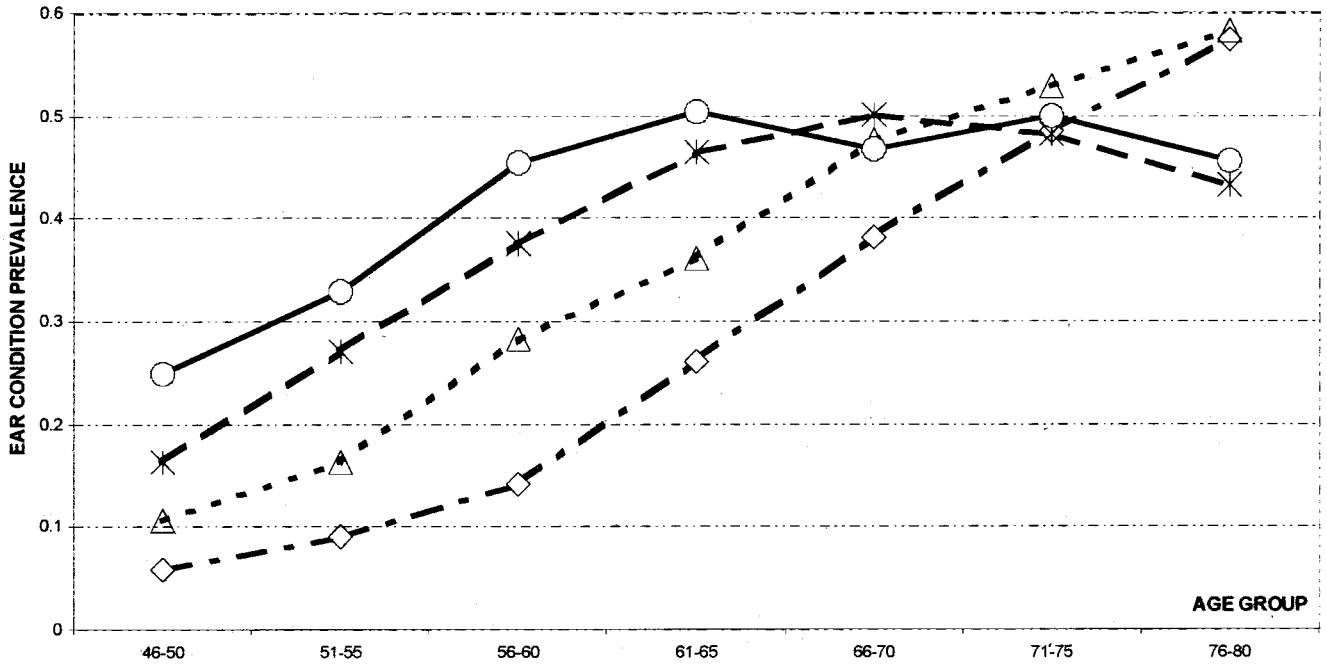

Fig. 3. 1825 to 1829 (dashed/dotted line); 1830 to 1834 (dotted line); 1835 to 1839 (dashed line); 1840 to 1844 (solid line). *Prevalence rate in an age group for a given birth cohort is defined by the number of veterans diagnosed with ear condition divided by the total number of veterans examined in that age group and birth cohort. Once diagnosed with ear condition, that condition remained for the rest of a veteran's life. Base populations for prevalence calculation varied from year to year.

ing unreported HL. From 1862 to 1920, 4,770 UA veterans complained of HL, resulting in 5,078 pensions filed (Table I). During this period, however, thousands of additional ear examinations occurred (Fig. 2). The number of examinations differs from the number of complaints because the applicants could receive an ear examination as part of a general examination without a complaint of HL.

The difficulty in identifying veterans with HL was compounded by the Pension Bureau's concern with malingering.[8] In prior studies using the UA dataset, we have shown that certain conditions, such as ear complaints and "nervous disorders," were received more suspiciously and rejected at higher rates by the Bureau.[10] Because HL may have no obvious physical finding, unlike a gunshot wound, for example, a claim for HL may have been more likely to be regarded as reflective of malingering.

The study provides insight into the etiology of HL among veterans. Presbycusis, defined as the age-related decline in auditory performance, is the most common cause of HL at present. Although more veterans received pensions for HL with age, few had bilateral HL (Fig. 1). The lack of bilateral HL may be explained by the life expectancy of only 48 years after the Civil War. This is well below the present life expectancy of 74 years, which likely affected the number of individuals with presbycusis.[11]

Noise-induced HL (NIHL) is another prevalent etiology of HL today, affecting an estimated 10 million individuals.[2] It may explain the majority of the unilateral HL in this study. One potential cause of NIHL is the use of a gun, with right-handed individuals having HL primarily in the left ear. We found that 70% of those with ratings for HL had a disability limited to the left ear. This finding is consistent with the veteran population in this study.

Noise exposure also may be related to employment type. Interestingly, we found no significant difference in HL prevalence among occupational categories (Fig. 4), an observation that may reflect the infancy of the industrial revolution within many of the occupations and the variety of professions contained within each category. For example, "artisans" included professions such as blacksmith, bricklayer, carpenter, cobbler, machinist, mason, painter, plasterer, and tailor. Although each of these professions required a special skill, they were variably associated with noise exposure. It is therefore not unexpected that the professional categories would show similar rates of HL.

The amount of compensation, however, did vary among occupational categories (Table III). For those with left-sided loss, professionals had the highest monthly dollar rating, followed by artisans, laborers, farm owners, and semi-skilled workers. One explanation for this finding was a partisan attempt to give preference in pension awards to certain groups of individuals in exchange for their political support.[12]

Differences in prevalence rates are also observed among birth cohorts. Veterans born later (i.e., the were younger during the Civil War) have an increased prevalence of HL when compared with earlier cohorts (Fig. 3). These veterans were younger when they were exposed to weapons during the Civil War. In addition, younger veterans had an increased opportunity to qualify for pension because they were more likely to survive until the passing of the 1890 Pension Act that expanded coverage to condi-

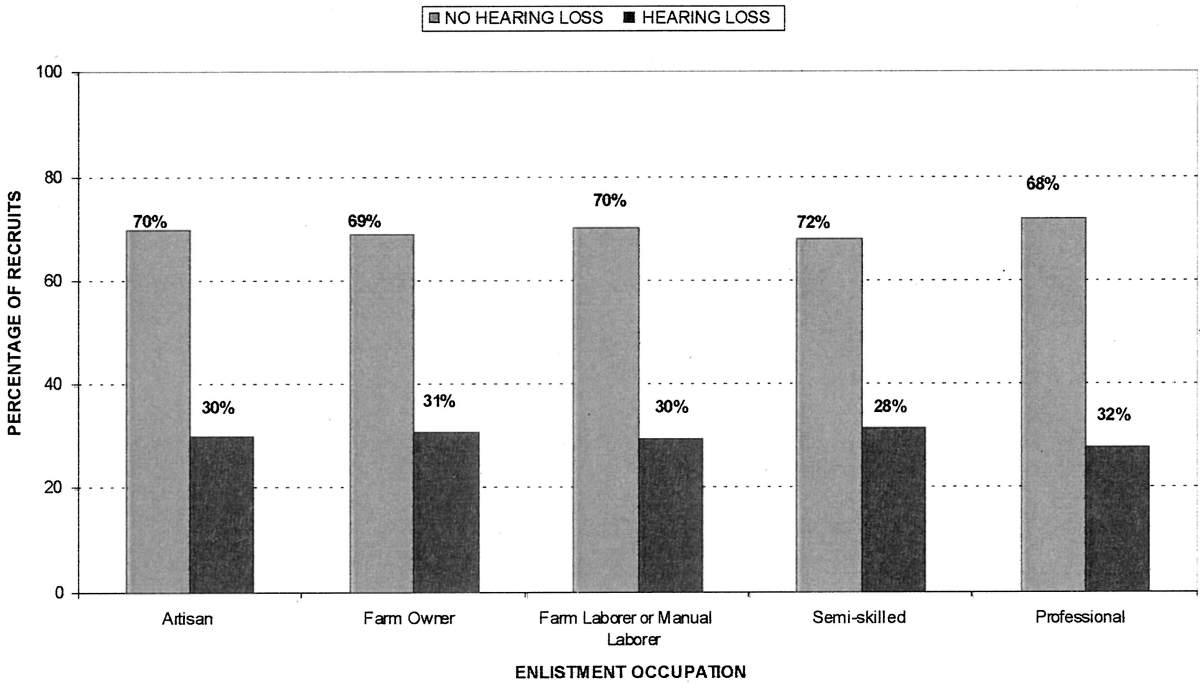

Fig. 4. No hearing loss (gray shading); hearing loss (hatched black shading). *Chi-square test indicates that the prevalence of hearing loss does not differ by occupation.

tions that were not directly war related. The largest increase in prevalence occurred in 1891 (Fig. 1), with the maximum number of examinations occurring only a year later (Fig. 2).

As a final observation, the compensation scheme of the UA pension program provides insight into public views about disability in the 19th century. Disability, at least indirectly, was defined as the limitation to perform manual labor. Today, the definition of disability remains essentially unchanged, for instance, in policy schemes such as Social Security. Today's veterans injured on active duty receive disability pensions based on the same criteria as did the UA veterans, that is, "reductions in earning capacity."[13] For HL, the level of disability is determined by discrimination and pure tone threshold levels. Scores for each ear are combined to determine a final disability rating, allowing for graded compensation depending on the level of disability.[14] For a veteran totally deaf in one ear and with normal hearing in the other, the disability is rated at 10%. Bilateral deafness (discrimination of 0–34%, pure tone threshold average 98+ dB) receives a disability rating of 100%.[14]

A civilian example found in the Social Security Administration programs defines disability as an inability to work.[15] Unlike present day veterans, however, no graded disability levels are used. Hearing impairment is consid-

TABLE III.
Average Monthly Dollar Ratings* in the Final Examination Between 1862 and 1907 by Occupation.

Enlistment Occupation	Number of Veterans with Nonmissing Dollar Ratings on the Left Ear	Average Monthly Dollar Ratings Either Right or Left Ear but Not Both	Number of Veterans with Nonmissing Dollar Ratings on Both Ears	Average Monthly Dollar Ratings Both Ears
Artisan	251	$11.52	0	N/A
Farm owner	614	$10.93†	1	$22.00
Farm laborer or manual laborer	144	$11.25	1	$15.00
Semi-skilled	45	$ 9.04‡	0	N/A
Professional	68	$11.56	1	$22.00
Totals/averages	1122	$11.17	3	$19.67

*Dollar ratings were assigned by examining surgeons to indicate to the Pension Bureau the severity of a particular disability. A larger dollar rating corresponded to a more severe impairment. The Pension Bureau aggregated dollar ratings from all conditions to assign a monthly pension award to a recruit.
†The t test indicates that farm owners had on average significantly lower monthly ratings than that of farm laborers and manual laborers at the 10% level.
‡The t test indicates that the semi-skilled had on average significantly lower monthly ratings than those of all other occupational categories at the 5% level.

ered a disability resulting in compensation if either the average hearing sensitivity threshold for air conduction is greater than 90 dB or speech discrimination is less than 40%.[15]

Despite similar definitions for disability, the amount of compensation differs between UA veterans, modern veterans, and Social Security pensions. UA veterans with unilateral HL received an average pension of $11.17 per month, or $134.04 per year, representing nearly one third of the average annual income in 1890.[16] The small number of individuals we identified with bilateral HL and identifiable pension amounts received nearly twice the average monthly dollar amount (Table III). Today, veterans with bilateral deafness are rated as having a total disability and are entitled to a pension equaling $2,193 per month. An added compensation of $81 per month applies to bilateral deafness, bringing the monthly total to $2,274, or $27,288 annually.[17] This amount is close to the average income today, representing an increased percentage from the Civil War period. Unilateral deafness, however, is considered less debilitating, with a monthly pension of $104, or an annual pension of $1,248. This is only 4% of the average income, well below the percentage received under the Civil War Pension for a similar disability.

Generally, Social Security disability benefits are less generous than are those for veterans under military pension schemes. Moreover, unilateral HL typically is not eligible for Social Security disability benefits. Even with bilateral HL, the compensation is less than that after the Civil War. An average 60-year-old individual with bilateral HL who earned $33,300 the previous year would receive approximately $948 a month, or $11,400 a year.[18] This is approximately one third of the income earned in the previous year, which corresponds to one half of the percentage a UA veteran received for bilateral loss.

CONCLUSION

The UA dataset provides a unique opportunity to explore the prevalence, etiology, and public perception of HL in late 19th century America. Our findings indicate that HL was a common disability among UA veterans, with NIHL the likely etiology. The variation in compensation levels, despite consistent disability definitions, may indicate differing perceptions of the effect HL has on earning potential. Additional study is required to assess the prevalence of HL throughout the 20th century as well as implications of this information for health, retirement, and mortality trends.[19] This information would aid in a more thorough understanding of the historic factors related to increased risk of HL in American society generally, and by veterans particularly.

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