Evolution of Disability in Late 19th Century America: Civil War Pensions for Union Army Veterans with Musculoskeletal Conditions

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This article examines the evolution of musculoskeletal (MSK) disability and its impact on mortality and work patterns in the late 19th century in America, in the context of the Civil War disability policy scheme. The study was conducted on 17,702 Union Army (UA) Civil War veterans. Of these, 10,789 were examined and diagnosed with major MSK conditions, rheumatism, sciatica, and spinal curvature, between 1862 and 1907. Analyses examine MSK (i) prevalence rates by birth cohort and age group; (ii) fatality rates as compared with other disabilities; (iii) risk rates by occupation type; and (iv) lifespan for MSK patients. MSK conditions are commonly claimed disabilities within the Civil War data set, with prevalence rates increasing with age. Regression studies show that working in clerical and professional (relative to manual labor) occupations decreases the likelihood of being examined for and diagnosed with MSK conditions. MSK patients examined at older ages tended to have longer lifespan than those examined at younger ages. The findings suggest that changes in age,
environmental, and occupational conditions during the late 19th century affected MSK condition prevalence and the average lifespan of MSK patients. Implications for contemporary disability policy are discussed. Copyright © 2002 John Wiley & Sons, Ltd.

INTRODUCTION

Progress in the medical assessment and evaluation of musculoskeletal disability (MSK) has occurred recently. In the last two decades, researchers have developed measures to assess the prevalence and impact of MSK conditions on health status and life outcomes.\(^1\) Researchers find a strong positive relationship between age and the development of MSK conditions such as spinal problems.\(^2\)

With recent policy emphasis on disability return-to-work strategies,\(^3\) the relation between labor force participation and MSK disability has received particular attention. Results are mixed: Some studies show a rise in recent years in MSK work disability rates.\(^4\) Other studies show a decline in functional disability in general.\(^5\)

One explanation for different reports on historical trends of MSK condition prevalence rates arises from the definition of MSK conditions employed.\(^6\) As Dionne and his colleagues point out, functional limitations, pain, and work status indices used to assess MSK conditions are not equivalent measures.\(^7\) Moreover, with passage of the Americans with Disabilities Act (ADA) of 1990, increased attention has been focused on a range of MSK disabilities (such as repetitive stress disorders) and their relation to job accommodations, ergonomic strategies, and workplace discrimination.\(^8\) MSK disabilities related to back impairments represent a high proportion of claimed impairments in ADA litigation.

The present study examines the evolution of MSK disability in late 19th century America, in the context of this country’s first major disability scheme—the Civil

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2Tom Mayer, Robert Gatchel, & Trent Evans, Effect of Age on Outcomes of Tertiary Rehabilitation for Chronic Disabling Spinal Disorders, 26 SPINE 1378–1384 (2001).
5Costa shows that functional disability (for instance, difficulty in walking, difficulty in bending, paralysis, but also blindness in at least one eye, and deafness in at least one ear) in the U.S. has fallen during the early 1900s to the 1990s at an average annual rate of 0.6% among men aged 50 to 74. She attributes one third (37%) of this decline to a reduction in chronic disease rates. See Dora Costa, Changing Chronic Disease Rates and Long-Term Declines in Functional Limitation Among Older Men, 39 DEMOGRAPHY 119–138 (2002).
War pension policy for disabled Union Army (UA) veterans. Although ample research has been conducted on MSK disability using contemporary populations, there is a lack of empirical study on MSK disability and its impact on late 19th century populations. This historical period coincided with the advent of industrialization (and the development of repetitive occupational tasks) and rise of American social insurance policy.9

This article, for the first time and with a unique cohort and database, examines historically the evolution of the MSK disability and attendant mortality, work patterns, and pension policy in late 19th century America. MSK disability trends are examined over time for a large sample of UA veterans in the Civil War pension scheme. The analysis is based on data derived from UA files and related pension medical exams (“Surgeons’ Certificates”).10

The investigation is based on a total sample of 17,702 UA recruits (with a documented birth date) whose medical examination certificates identify a subsample of 10,789 recruits with different forms of MSK disability. The first part of this article highlights the operation of the UA Civil War pension scheme. The second part presents findings of MSK condition prevalence rates for different groups in the sample as well as longitudinal and cross-sectional analyses of MSK disability by birth cohort and age group. Regression analyses examine whether certain occupations increase the likelihood of MSK disability and compare the average lifespan of MSK patients belonging to different age groups, birth cohorts, and occupational categories. The third part discusses implications of the findings for contemporary disability policy.

**UA DISABILITY PENSION SCHEME: OVERVIEW**

There are two primary periods in the Civil War pension system.11 The first is known as the “General Law” era. During the General Law’s primary years, from 1862 to
1890, disability pensions were awarded to UA veterans based on war-related injuries and impairments. The second period, which began in 1890 and ended in 1907, is known as the “Service Pension System.” Veterans were awarded pensions according to their length of military service and age.12

The 1862 General Law instructed that the Pension Bureau award pensions to UA veterans who suffered permanent injury or disabilities as a direct consequence of military service. A medical board screened disability claims according to the individual’s capacity “for the performance of manual labor requiring severe and continuous exertion.”13 The definition of disability in relation to the ability to perform manual labor was interpreted later to include other types of labor that required “education or skill.”

The Pension Bureau instructed local physicians to rate claimants’ disabilities and to complete standard “surgeons’ certificates.” Medical certificates were required for initial pension claims and for increases in pension awards. The surgeon’s certificate documented the conditions and disabilities that rendered the claimant unable to perform manual labor. The Pension Bureau then rated the disabilities according to an administrative schedule established by law. For instance, under the Act of 1862, an army private received a maximum of $8 per month for being rated as totally disabled to perform manual labor. A veteran whose disability was rated less than “total” received a proportion of that $8.

In response to the growth of the pension system, in 1873 Congress passed the “Consolidation Act,” which assigned grades to impairments in compensating war-related conditions. Another significant development occurred in 1879, when Congress passed the Arrears Act, which provided that veterans could receive a lump sum equivalent to pension back payments that should have been granted as a result of their military service during the Civil War.

The 1890 Disability Act marked the beginning of a universal disability and old age pension scheme for the UA veterans. Unlike the General Law, the 1890 Act was a service-based pension system, compensating veterans’ disabilities based on the length of military service. The 1890 Disability Pension Act was, up to that time, the most costly and liberal pension measure in the world.14

In 1907, the law was changed to allow for pension awards based solely on the veteran’s time of service and age. The 1907 law provided that veterans over the age of 62 were to receive pensions, with graduated increases in payments with age, regardless of the claimant’s income level and health condition. Most of the veterans pensioned under the 1890 Act transferred to the rolls under the 1907 Act to receive

12For reviews of the UA pension scheme, see William H. Glasson, Federal Military Pensions in the United States 125 (1918); Dora L. Costa, The Evolution of Retirement, An American Economic History 1880–1990, 197–212, 936 (1998); Claudia Linares, History of the Civil War Pension Laws, in Data Users Manual, supra note 10, at 329–354. The General Law continued and coexisted with the 1890 Act. However, after 1890 relatively few veterans invoked the General Law, even though its pension awards tended to be higher. This was because large numbers of veterans with impairments that were not war related now could receive pensions under the 1890 Act. Also, technically the 1890 Act did not end in 1907, it was modified that year to comport with the Age legislation, and few veterans applied under the 1890 Act after that date.

13See generally Blanck, supra note 11, at 150–151 (discussing total disability as a measure of inability to perform manual labor; and noting that pension ratings greater than 100% total disability, though uncommon, could be awarded where attendant care services for severely disabled veterans were required).

14See Skocpol, supra note 11, at 114; Glasson, supra note 12, at 233.
higher rates. Between 1870 and 1910, the proportion of veterans receiving pensions rose from 5 to 93%. By 1907, it was estimated that UA pensions had cost taxpayers over $1 billion.\textsuperscript{15}

**DATA ANALYSIS**

The Civil War data set includes the Military Pension Records (the Military Data), which contain information on 35,747 white male UA veterans. The data capture socioeconomic, military, and pension information for these veterans throughout their lives. In addition, the surgeons’ certificates (the surgeons’ data) provide information on claimed disabilities on which Pension Bureau bases pension monetary awards.

The surgeons’ data contain 87,223 exam records for 17,702 pensioners with a documented birth date (an average of 4.93 exams per veteran) from 1862 to 1940. The majority of exams occurred between the years 1885 and 1920. Each exam records symptoms, diagnoses, and assigned disability ratings according to the veteran’s incapacity to perform manual labor.

The exams are classified by disability type. There are 18 disability types as well as a general health screen that assesses body organs and systems mentioned in the surgeons’ certificates. The disability types include systems such as cardiovascular, ear and eye, gastrointestinal, genito-urinary, respiratory, musculoskeletal, liver/spleen/gallbladder, as well as infectious diseases and fevers, injury, neoplasm/tumor, nervous disorders, rectum/hemorrhoids, varicose veins, hernia, and general appearance conditions involving mainly blood, nutrition and skin, gum and teeth and muscles. In this study, we examine the MSK disability group, defined by any one of three conditions: rheumatism, sciatica, and spinal curvature.

The rheumatism variable specifies the part of the body in which inflammation of the joint or muscle was detected, such as “back hips,” “shoulder left side,” “lumbar rib” or “wrist finger joint.” The sciatica variable is identified when the claimant had pain or tenderness of the sciatic nerve. The spinal curvature or deformity variable conveys information about the location of kyphosis, scoliosis, or lordosis as well as the severity of the condition.\textsuperscript{16}

For each exam that presented one of the three MSK conditions, the dummy variable was coded as 1. If none of the three conditions were found, the MSK dummy variable was coded as 0. MSK condition prevalence rate is defined as the number of MSK patients divided by the total number of patients alive (MSK and non-MSK) in a given sample.

We assume that an MSK condition was a chronic condition that was not curable. This assumption is based on historical studies of disease development; for instance, during the period of interest, rheumatology was not developed and treatment was imperfect.\textsuperscript{17} Likewise, in the 19th century, scoliosis was thought to be caused by

\textsuperscript{15}See id. at 238.

\textsuperscript{16}Severity is identified in some cases, such as “kyphosus moderate”, and “lordosis lumbar severe.”

\textsuperscript{17}CHARLEY SMITH & RICHARD FREYBERG, HISTORY OF RHEUMATOLOGY 2 (1985).
poor posture and treatment included bracing of various types, traction beds, and exercises.\textsuperscript{18}

Not until 1895, with the advent of Roentgenographs that allowed the visualization of a deformed spine, was there a means for the monitoring and quantifying disease progression.\textsuperscript{19} Before 1895, given that radiographs were not available, most vertebral fractures eluded diagnosis unless they were manifested by paralysis. With the emergence of radiographs, imaging of fractures was possible and led to a certain diagnosis.\textsuperscript{20}

Compared with studies using modern MSK disability diagnostic techniques, three distinct features apply to the present analysis. First, because the UA pension scheme was restricted to veterans, the base sample was not replenished over time, but instead shrank gradually as recruits aged. Second, as mentioned, the 1890 Pension Act lifted the prior restriction that pensions could be awarded only for war-related injuries and conditions. The 1890 law resulted in a substantial increase in claimants and pension applications. Although a markedly larger sample may increase the robustness of the findings, many of the post-1890 claimants may have had MSK disabilities before 1890. Therefore, if a claimant’s MSK condition was not directly war related, he would have been disqualified from a pension prior to 1890. MSK condition prevalence rates thereby likely are underestimated prior to 1890.

Third, the sample includes claimants with at least one disability. In the calculation of disability prevalence rates in contemporary studies, the population often consists of individuals with a particular disability or multiple disabilities, and healthy individuals without any disability. Therefore, prevalence rates derived from the Civil War sample overestimate the actual prevalence rates of the general population.

Having stated the potential limitations of the Civil War sample, we proceed with two studies. The first study is of a descriptive nature. We compute MSK condition prevalence rates by birth cohort and age group, as well as the “fatality rate” of MSK disabilities as compared with other disabilities. Fatality rate is defined by the ratio of MSK claimants who die annually over all MSK claimants. Although the cause of death was not necessarily identified as MSK conditions, we assume MSK conditions to be a contributing factor. Given that we cannot be certain of the cause of death for MSK patients, we refer to the ratio as “fatality rates” instead of “mortality rates.”

The second study applies the regression technique.\textsuperscript{21} We develop two MSK condition risk measures: odds of being examined and diagnosed with an MSK condition, and the remaining years of survival after contracting an MSK condition. Regression models are constructed to evaluate the impact of enlistment occupation on the risk of MSK disability, controlling for age and birth cohort.

\textsuperscript{18}Moen & Nachemson, \textit{supra} note 9.

\textsuperscript{19}Id.


PRELIMINARY RESULTS

Prevalence Rates

Table 1 shows MSK disability as the most common cause of disability among UA veterans. Roughly one-sixth (16.90%) of all exams (22,191 of 131,278) document this condition. As expected, the second most common disability claimed relates to war injuries and gunshot wounds (16.34% of all exams). Given the gradual aging of the sample, we observe cardiovascular impairment as the third most prominent disability (11.63% of all exams).

Figure 1 next presents the aggregate prevalence rates of MSK conditions from 1865 to 1920. Prevalence rates increase over time as the population aged. The largest increase in aggregate prevalence rates occurred in 1890. The steep rise in the prevalence rate likely was due to the fact that the 1890 Pension Act recognized conditions not directly war related. Prior to 1890, recruits may have had MSK disabilities, yet were not able to claim them as pensionable conditions, leading to an underestimation of true prevalence. Without such an underestimation, the time profile of MSK condition prevalence should not display a slope as steep as that observed in Figure 1 from 1865 to 1890, although it still should maintain the increasing trend over time.

The aggressive rate of growth in MSK condition prevalence from 1880 to 1889 in Figure 1 illustrates the effect of the 1879 Arrears Act combined with an increasingly expansive pension scheme. During this time, generous pension awards compensated disabilities that were excluded under the 1862 General Law.

A change in the curvature of the MSK condition time–prevalence profile occurred in 1890. Until that time the growth rate had been convex. From 1890 onwards, however, the increase in prevalence rates shows a concave pattern. A concave pattern implies a decline in the growth rate of MSK condition prevalence given that the average age was 55 in 1890. By 1907, with the aging of the sample and

Table 1. Number of exams per disease group from 1862 to 1907*

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

*An exam could identify multiple diseases.
advent of the age and service-based pension scheme, MSK condition prevalence rates stabilized.

Figure 2 presents the prevalence rates by birth cohort. Each line in the figure corresponds to the age–prevalence profile of a given birth cohort. Confirming the finding in Figure 1, prevalence rates of MSK conditions increase with age. In addition, however, older cohorts had lower prevalence rates at younger ages (i.e. from 46 to 50, until 66 to 70 years of age). For instance, at the age of 46–50, a recruit born between 1815 and 1819 was much less likely (10%) to have an MSK condition than a recruit born after 1819 (e.g. 40% for the cohort born between 1840 and 1844). Similarly, at the age of 60, a recruit born between 1815 and 1819 was almost three times less likely to have an MSK condition (23%) than a recruit born between 1835 and 1839 (65%). The birth cohort differences are dramatic at times; a 60-year-old veteran born between the years 1840 and 1844 was three times more likely to suffer an MSK condition (69%) than a 60-year-old veteran born between 1815 and 1819 (23%). Likewise, a 65-year-old veteran born between 1840 and 1844 was more than twice as likely (72%) to be diagnosed with an MSK condition as compared with a 65-year-old veteran born between 1815 and 1819 (30%).

Although the trends in Figure 2 are less consistent and somewhat reversed for the oldest age intervals, prevalence rates after age 80 are not reliable due to small sample sizes. It is likely that with a larger sample the order of prevalence by birth cohorts at older ages would match that of younger ages. If validated by further research, the birth cohort finding suggests that changes in environmental and occupational conditions (and labor force composition) during the 19th century may have led to drastic increases in the prevalence of MSK conditions.

Figure 1. Musculoskeletal (MSK) condition prevalence rates from 1865 to 1920. *

* MSK condition prevalence rate in a given year is defined as the number of recruits diagnosed with MSK conditions divided by the total number of recruits being examined in that year. Base populations for the MSK condition prevalence calculation varied from year to year.
Another possible explanation for the birth cohort effect may relate to differences in the health and socio-economic characteristics of, or discrimination against, the birth cohorts themselves. For instance, among the ranks of the UA were large numbers of foreign-born recruits. At the start of the Civil War, almost 15% of U.S. residents were foreign born, with the majority migrating to Northern states where the demand for manual labor was strong. The composition of the birth cohorts may be influenced by the health status and economic status of early versus later foreign-born veterans. Alternatively, differential MSK condition diagnosis rates by birth cohort might have been affected by preferential or discriminatory attitudes and practices of the Pension Bureau, its administrators, and examining surgeons, for instance reflected in stigma associated with particular impairments.

Figure 3 presents the prevalence rates over time by age group. We restrict the time period to years prior to 1907, because after that year the Age Act was in effect and veterans could claim old age UA pensions regardless of disability.

For the most part, these lines display an increasing trend over time. This means, for example, recruits between ages 40 and 49 in 1890 had a higher MSK condition prevalence for a given birth-age cohort as defined by the number of recruits diagnosed with MSK divided by the total number of recruits examined in that cohort. Base population for the prevalence calculation varied from cohort to cohort.

24See generally Isaac M. Rubinow, Social Insurance with Special Reference to American Conditions 406–407 (1913).
25See Blanck, supra note 11, at 129–135 (discussing disability stigma and pension scheme); Blanck & Song, supra note 11, at 209–212 (discussing partisan forces on disability pensions).
prevalence (48%) than recruits between 40 and 49 in 1880 (12%). The trend suggests that even statistically controlling for age, MSK conditions are more prevalent over time for any given age group.

It is likely that such a trend is, to some degree, an artifact of the changes in sample size resulting from the legislative changes occurring between 1870 and 1890. However, the pension legislation itself only goes so far in explaining the pattern. In fact, after 1890, once the legal structure of the pensions' program settled, prevalence rates still display an increasing trend albeit at a slower rate. Thus, the trend in Figure 3 is in accord with the interpretation of Figure 2, that changes in environmental and occupational conditions during the later part of the 19th century may have led to an increases in MSK prevalence rates.

**Fatality Rates**

Figure 4 compares MSK condition fatality rates with fatality rates of other conditions identified in Table 1. The MSK condition fatality rate is the ratio of MSK condition claimants who died annually over all MSK condition claimants. The fatality rate of other conditions is the ratio of claimants who died of other conditions over all recruits claiming other conditions. We restrict the analysis to years prior to 1907.

In any given year, we assume the MSK condition to be a contributing factor to a veteran’s death, though possibly not the main cause of death. To that extent, fatality rates measure the lethality of MSK conditions. Figure 4 indicates that before 1895 the difference between MSK condition fatality rates and fatality rates of other disabilities was not substantial.
After 1890, however, fatality rates of MSK claimants were markedly lower relative to other disabilities. In 1904, the MSK fatality rate was only about 2.5%, whereas the fatality rate of other disabilities was approximately 6%. MSK disability therefore was a debilitating disability but likely not more lethal (and perhaps much less with age) than other disabilities.

Risk Rates

To this point, we have examined descriptive relationships in the research model. Regression analyses are used next to explore the extent to which the odds of being examined and diagnosed of MSK conditions may be predicted by the set of age and birth cohort variables identified earlier, while controlling statistically for the interdependence among those variables.

Table 2 presents the logistic multiple regression on the odds of contracting MSK conditions for the UA sample. The table provides the definitions of the variables under study (left column), their means, and the associated probability of contracting the MSK condition presented as an “odds ratio” (OR) for two regression models.26 The asterisks to the right of the OR reflect that probability’s degree of statistical significance.

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Table 2. Regression model explaining the odds of diagnosis of musculoskeletal conditions (msk) for 16,548 recruits who were examined for at least one disability between 1862 and 1907, and 6,493 recruits who were examined for at least one disability between 1890 and 1907, controlling for enlistment occupation, age at the first examination, and birth cohort

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1A 1862–1907</th>
<th>Model 1B 1862–1907</th>
<th>Model 2A 1862–1907</th>
<th>Model 2B 1890–1907</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ever contracted musculoskeletal condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 39 or younger</td>
<td>20.52%</td>
<td>0.02%</td>
<td>0.32***</td>
<td>n/a(^1)</td>
</tr>
<tr>
<td>Age between 40 and 45</td>
<td>19.83%</td>
<td>9.50%</td>
<td>0.59***</td>
<td>1.43**</td>
</tr>
<tr>
<td>Age between 46 and 50</td>
<td>22.34%</td>
<td>30.95%</td>
<td>0.81***</td>
<td>1.67***</td>
</tr>
<tr>
<td>Age between 51 and 55</td>
<td>16.14%</td>
<td>24.95%</td>
<td>0.87**</td>
<td>1.23*</td>
</tr>
<tr>
<td>Age 56 or older</td>
<td>21.18%</td>
<td>34.59%</td>
<td>(omitted)</td>
<td>(omitted)</td>
</tr>
<tr>
<td>Birth cohort</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Born before 1831</td>
<td>18.48%</td>
<td>13.04%</td>
<td>0.40***</td>
<td>0.88</td>
</tr>
<tr>
<td>Born between 1831 and 1835</td>
<td>14.05%</td>
<td>12.81%</td>
<td>0.59***</td>
<td>1.26</td>
</tr>
<tr>
<td>Born between 1836 and 1840</td>
<td>24.24%</td>
<td>23.08%</td>
<td>0.67***</td>
<td>1.03</td>
</tr>
<tr>
<td>Born between 1841 and 1845</td>
<td>34.01%</td>
<td>36.81%</td>
<td>0.78***</td>
<td>0.84</td>
</tr>
<tr>
<td>Born after 1845</td>
<td>9.22%</td>
<td>14.26%</td>
<td>(omitted)</td>
<td>(omitted)</td>
</tr>
<tr>
<td>Enlistment occupation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enlistment occupation farmer</td>
<td>57.00%</td>
<td>53.40%</td>
<td>1.04</td>
<td>0.93</td>
</tr>
<tr>
<td>Enlistment occupation professional</td>
<td>2.24%</td>
<td>2.54%</td>
<td>0.75***</td>
<td>0.73*</td>
</tr>
<tr>
<td>Enlistment occupation clerk</td>
<td>4.28%</td>
<td>5.19%</td>
<td>0.73***</td>
<td>0.83</td>
</tr>
<tr>
<td>Enlistment occupation artisan</td>
<td>18.88%</td>
<td>19.28%</td>
<td>0.91*</td>
<td>0.94</td>
</tr>
<tr>
<td>Enlistment occupation laborer</td>
<td>16.81%</td>
<td>18.34%</td>
<td>(omitted)</td>
<td>(omitted)</td>
</tr>
<tr>
<td>Enlistment occupation unclassified/not identified</td>
<td>0.80%</td>
<td>1.25%</td>
<td>0.97</td>
<td>0.83</td>
</tr>
</tbody>
</table>

**Statistical significance at the 1% level.**

***Statistical significance at the 5% level.**

*Statistical significance at the 10% level.

\(^1\)The number of observations in this category is too small for a meaningful odds ratio to be calculated.
The OR shows, on average, within each variable such as age at first examination, birth cohort, and enlistment occupation, the additional likelihood of contracting an MSK condition by belonging to a category relative to a reference category in that variable. For instance, under enlistment occupation, there are six categories: farmer, professional, clerk, artisan, laborer, and enlistment occupation missing. The reference category (or the omitted category in the regression) is laborer.

In model 1A, therefore, an OR of 0.75 in the professional category means that these recruits were 0.75 times as likely (or $1 - 0.75 = 25\%$ less likely) to contract MSK than recruits in the laborer reference category. An OR of 0.73 in the clerk category means that recruits in this category were 0.73 times as likely (or $27\%$ less likely) to be diagnosed with MSK than recruits in the laborer category. ORs that are greater than unity indicate a greater likelihood relative to the reference category. ORs that are less than unity indicate a lower likelihood relative to the reference category.

In Table 2, the asterisks denoting “statistical significance” indicate whether the average influence from each categorical variable quantified and presented as the OR is due to random sampling, or is substantial enough that we would likely achieve the same qualitative result had we performed this analysis on another sample as representative as the current one. The number of asterisks increase with the degree of statistical significance of the marginal effect, with three being the most significant, and one asterisk being the least significant but still substantially noticeable from a statistical standpoint.

An OR that is statistically significantly different from one implies that the higher or lower likelihood compared to the omitted category is most likely not due to chance. For example, the OR of 0.75 is statistically significant, so there is a substantial difference in the probability of contracting an MSK condition between recruits in the professional and laborer occupations.

We observe in Table 2 the results of the regression explaining the odds of contracting an MSK condition by occupation type. Two models are presented (in the right-hand columns of the figure) estimating MSK prevalence by enlistment occupation (model 1) only, and in addition by age at first pension exam and birth cohort (model 2). Within each model, we experiment with the entire sample of recruits examined between 1862 and 1907, as well as a sub-sample of recruits examined only after 1890. The selection of the sub-sample tests whether the findings are sensitive to the change of pension legislation in 1890, which may have brought in MSK claims previously not recognized as being directly war related.

The two left columns display variable means for the periods 1862–1907 and 1890–1907. The average age in the later year sub-sample is older than the entire sample. Also, as earlier birth cohorts are phased out, the later year sub-sample is composed of recruits born more recently.

When applied to the entire sample, model 1A shows that veterans in more sedentary occupations, such as professional and clerical ones, had significantly less likelihood to be diagnosed with MSK conditions compared with manual laborers. Relative to laborers, the likelihood of MSK condition diagnosis for professionals is 0.75, and for clerks 0.73 (for artisans 0.91). We observe that farmers are not substantially different from laborers in their odds of contracting an MSK condition. Restricting to only the later year sub-sample eliminates the significance of the clerks.

\[27\text{For similar analyses, see Blanck & Song, supra note 21.}\]
and artisans as illustrated in model 1B, but the odds of contracting an MSK condition for professionals still remain significantly below that of the laborers (i.e., 0.73).

Model 2A confirms the age and birth cohort effects identified in Figures 2 and 3; that is, all else equal, younger recruits at first exam and those born earlier are less likely to be diagnosed with MSK conditions. In model 2A corresponding to the entire sample, even after controlling for age at the first examination and for birth-cohort effects, we still obtain similar results on the enlistment occupation as in model 1A.

However, the same cannot be concluded from model 2B with the later-year sub-sample. Adding age and birth cohort controls obscure the results on enlistment occupation. In addition, OR estimates for the age groups are in the opposite direction from those in model 2A. Instead of the younger age group having lower likelihood of being diagnosed with an MSK condition in model 2A, they are more likely to be diagnosed with an MSK condition in model 2B. Results in model 2B therefore more likely reflect the effects of the 1890 Act rather than indicating a true relationship between occupation and the odds of contracting an MSK condition.

Table 3 shows the ordinary least squares (OLS) regression on veterans’ number of years to live after being diagnosed with MSK conditions.28 Table 3 contains only recruits who were diagnosed with MSK conditions, whereas Table 2 contains those with and without MSK conditions. Again, we study the entire sample from 1862 to 1907 and the sub-sample from 1890 to 1907.

Comparing the sample in Table 2 with that in Table 3, MSK patients, on average, are older than non-MSK patients. For example, in model 1A, combining MSK and non-MSK patients, 21.18% were of age 56 or older (Table 2), whereas 36.36% of the MSK patients belonged to that same age group (Table 3). Compositions of birth cohort and enlistment occupation are almost identical between those two samples.

For the sample of 10,789 MSK patients pertaining to the entire period in model 1A, the average number of years to live after being diagnosed with an MSK condition was 20.41. The OLS coefficient estimates (right-hand columns in Table 3) show the number of additional years individuals in that category live relative to the omitted reference category. Controlling for the independent effects birth cohort and enlistment occupation, we observe substantial differences in the remaining number of years to live between the lifespan of younger and older MSK patients. However, a closer comparison of age at death among all age cohorts implies that it was the oldest age cohort that had the longest life span.

For instance, in model 1A, MSK patients aged 39 or younger at their first pension examination had an average of 19.18 more years to live than those aged 56 or older. However, the average years of age difference between those two cohorts are 27.4 (62.2 – 34.8). Therefore, the oldest age cohort enjoyed an extra 8.2 (27.4 – 19.18) years of longevity more than the youngest age cohort.

Similarly, longevity between the cohort aged 40 to 45 is lower than that of the oldest cohort, because the coefficient estimate of 12.92 is smaller than the average age difference of 18.8 (62.2 – 43.4). Consequently, the oldest age cohort enjoyed 5.9 (18.8 – 12.92) more years of longevity than the cohort aged 40 to 45. Applying the same logic, the oldest age cohort enjoyed an extra 4.9 (62.2 – 48.0 – 9.30)

28As in Table 2 supra, the asterisks denote “statistical significance.” See Blanck & Song, supra note 21 (discussing OR and OLS regressions).
years of longevity than the cohort aged 46 and 50, and an extra 3.6 (62.2 – 52.9 – 5.71) years of longevity than the cohort aged 51 and 55.

When we restrict the investigation of years to live to only the later year sample between 1890 and 1907, the results do not vary significantly. Comparing model 1B with model 1A in Table 3, the OLS coefficient estimates have the same signs and similar magnitudes. The only exception is the coefficient estimate on the age group 39 or younger (8.39 under model 1B in Table 3). From the variable means column under model 1B, only 0.03% of the recruits belonged to this group. Therefore the difference between model 1A and model 1B is due to the much smaller group size of recruits younger than 39 in the later year sample.

To summarize the effect of age on the longevity of MSK patients, although younger age cohorts had more years to live after being diagnosed with MSK conditions than the older age cohorts, after taking into account the average age gaps among different cohorts, it is the oldest age group that enjoyed the longest lifespan. Another way to interpret this result is that MSK patients who were examined at older ages tend to die at an older age than those who were examined at younger ages. This is perhaps due to the fact that recruits who were examined after 55 tended to be healthier than those examined at an earlier age.
Controlling for age at the first examination, model 1A in Table 3 shows that MSK patients who were born before 1831 lived on average 1.86 years less than those who were born after 1845. Moreover, those born between 1836 and 1850 lived on average 0.85 years less than the group born after 1845. Controlling for age, the youngest birth cohort enjoyed the longest remaining years to live after being diagnosed with MSK conditions.

Lastly, the findings for the enlistment occupation variable in Table 3 show that farmers diagnosed with MSK conditions live 1.85 more years (significantly), and professionals 1.08, than the reference group laborers. This model suggests that, all else equal, the longest lifespan is enjoyed by a farmer who was born after 1845 and who is first examined at age 56 or older. On the other hand, Table 2 shows that the occupation of farmer increases the likelihood (although not significantly) of being diagnosed with MSK conditions. Consequently, veterans who are farmers have longer life spans, but perhaps of lower quality due to MSK disability.

**IMPLICATIONS**

This study explores MSK disability prevalence and prediction in late 19th century America. The Civil War data provide a large sample for research on UA pension policy, advent of industrialization and occupational specialization, and rise of American social insurance policy.

The findings show that MSK conditions are a prevalent and increasingly common disability in the later part of the 19th century. MSK condition prevalence increases as the population aged and affected older cohorts less than younger ones. The findings suggest that changes in demographic and occupational composition in late 19th century America are, in a large part, responsible for changes in MSK condition prevalence. White male UA veterans who worked in sedentary occupations are significantly less prone to be diagnosed of MSK conditions. Among those diagnosed with MSK conditions, the oldest age group enjoys the longest lifespan. Clerks born before 1831 live significantly fewer years relative to others sampled.

One limitation of this study is that the data analysis considers MSK disability as an all-or-nothing categorical variable. The next step is the construction of a composite health index, either directly from the surgeons’ ratings for each disability or indirectly from symptoms pertaining to each disability. A composite index will more accurately separate the disability type and severity contribution from the non-disability contribution (for instance, birth cohort, occupation, and so on) on pension outcomes. This will enable assessment of the relative importance of non-disability forces (e.g. attitudinal discrimination) while statistically controlling for impairment type and severity, as well as for claimants health and mortality rates.

Information from a composite health index in the Civil War data set has relevance for contemporary policy researchers modeling disability and environmental factors that impact individual behavior in claims for government benefits (such as for Social Security Disability Insurance—“SSDI”), subsequent labor force participation, and retirement trends. The index may help to assess the relation between contemporary

29In subsequent studies, we shall examine whether similar trends are found for African–American UA veterans.
policies such as SSDI and the ADA, and the relative labor force participation of persons with different disabilities, such as persons with MSK as compared to those with mental disabilities.  

Despite its limitations, the present sample captures information on three different prominent MSK conditions as well as on pain location. Future study will examine the ways in which UA veterans were affected by MSK conditions in terms of pension outcomes, retirement trends, and mortality rates. UA pension rates may be used as one measure of individual health, comorbidity trends, and life outcomes.

Historical and empirical information from the Civil War data provides new insight into the nature of MSK disability, its prevalence, and influence on the lives of this large cohort. Still, the Civil War pension scheme benefited those disabled whom society, politicians, and courts deemed “worthy.” This monetary subsidy in turn influenced disabled UA veterans’ labor force participation, wealth accumulation, retirement, and health in later life. Future study may use such historical benchmarks in the examination of MSK disability and contemporary disability policy.

Lastly, examination is warranted of the recent demographics of MSK work disability, societal approaches to workers with MSK disabilities, and health care providers’ roles in evaluations of ADA workplace accommodations and return-to-work strategies. Review of the National Health Interview Study shows that 31 million persons aged 18–69 are restricted in the major life activity of working. Of these individuals, approximately 16%, or almost 5 million people, have MSK (primarily orthopedic) impairments.

Considering that by the year 2000, the costs to employers associated with MSK (primarily back) injury alone in the workplace approached $40 billion, examination is warranted of the savings related to MSK assessment, accommodation strategies, injury prevention, and wellness programs. Undoubtedly, researchers increasingly will be called on to assess MSK disability prevalence and its relation to work, health, retirement, and mortality.

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33 Blanck & Pransky, supra note 30, at 581–593.


36 See Peter Blanck, The Economics of the Employment Provisions of the Americans with Disabilities Act: Part I—Workplace Accommodations, 46 DePaul L. Rev. 877, 913–14 (1997); Peter Blanck, The Americans with Disabilities Act: Issues for Back and Spine-Related Disability, 19 Spine 103 (1994). See also Edward Yelin, D. Sonneborn D, & L. Trupin, The Prevalence and Impact of Accommodations on the Employment of Person 51–61 Years of Age with Musculoskeletal Conditions, 13 Arthritis Care & Research 168–176 (2000) (finding that use of workplace accommodation was associated with more severe MSK functional limitations and those with higher incomes were more likely to be accommodated, but from 1992 to 1994 accommodation was not associated with increased employment levels for persons with disabilities between 51 and 61 years of age).