Published in final edited form as:

Econ Hum Biol. 2013 July ; 11(3): 269–280. doi:10.1016/j.ehb.2012.12.001.

Was What Ail'd Ya What Kill'd Ya?

Robert W. Fogel,

Center for Population Economics Booth School of Business, University of Chicago
rwf@cpe.uchicago.edu ph: (773)834-8127 fax:(773)702-2901

Louis Cain,

Loyola University Chicago Northwestern University lcain@northwestern.edu

Joseph Burton, and

Center for Population Economics Booth School of Business, University of Chicago
jburton@uchicago.edu

Brian Bettenhausen

Center for Population Economics Booth School of Business, University of Chicago
bbett@cpe.uchicago.edu

Abstract

Making use of those Union Army veterans for whom death certificates are available, we compare the conditions with which they were diagnosed by Civil War pension surgeons to the causes of death on the certificates. We divide the data between those veterans who entered the pension system early because of war injuries and those who entered the pension system after the 1890 reform that made it available to many more veterans. We examine the correlation between specific medical conditions rated by the surgeons and death causes to gauge support for the hypothesis that death is attributable to something specific. We also examine the correlation between the accumulation of rated conditions to the length of time until death to gauge support for the “insult hypothesis.” In general, we find support for both hypotheses. Examining the hazard ratios for dying of a specific condition, there is support for the idea that what ail'd ya' is what kill'd ya'.

Keywords

chronic disease; hazard ratios; insult hypothesis

1. Introduction*

Using the Early Indicators life cycle health histories of Union Army veterans, we compare the conditions with which they were diagnosed by Civil War pension surgeons to the death certificates of veterans (and other documents that declare a cause of death). There have been an increasing number of studies exploring early life conditions on later-life outcomes, many motivated by Barker's “fetal origins hypothesis.”¹ This paper explores the association between later-life outcomes (death causes) and chronic conditions somewhat earlier in life.² The facts that Civil War era medical training and diagnoses were questionable but

*The authors are grateful for the editorial comments of John Komlos and five anonymous referees as well as for the epidemiological insights of Lauren Cain. We thank our discussants at the 2010 Economic History Association and Social Science History Association meetings and seminar participants at DePaul University, Northwestern University, the University of Chicago, and the University of Illinois at Chicago.

¹Barker (1992 and 1994)

²To the best of our knowledge, this is the first study to make use of the death cause data in the Union Army data.

improving over the lifetimes of these veterans and that the pension surgeon who diagnosed a condition was likely to be a different and, on average, older person than the doctor who signed a death certificate provide reason for this exercise. How strong was the connection between the disease burden of these veterans and their stated cause of death? We examine specific chronic disease conditions and causes of death to explore the hypothesis that death is likely attributable to a single chronic condition. We will also present evidence in regard to the “insult hypothesis” of mortality.

The Union Army database is a sample of white males who were mustered into the army. We have limited the data to those veterans for whom we have information on at least one medical exam and a death cause. The medical information is part of the “surgeons’ certificates” database; it is the product of comprehensive physical examinations completed by an appointed member of a local pension surgeons’ board detailing the health and disability status of Union Army veterans who applied for a pension. The death cause comes from a death certificate or some alternative document that declares a cause of death.³

Our sample is divided into two groups. The first are “injured” veterans who were either injured during the war or developed a chronic condition related to wartime service; this group was immediately eligible for pension funds. The second, “uninjured” veterans, entered the pension system after the 1890 reforms that made the pension available to many more veterans, first on the basis of identical chronic conditions that were not war-related and then, after 1907, on the basis of age. Pension awards were related to a veteran’s health status as recorded on the surgeons’ certificate. The examinations were conducted according to examination standards and procedures set by the U.S. Bureau of Pensions. The Bureau’s disease definitions, while they differ from current disease classification schema, are used in this analysis (Costa, 1998). Semantic and diagnostic differences arising from the disparity between 19th century medical knowledge and current medical understanding are noted. This is discussed in detail below.

Pension surgeons did not diagnose conditions *per se*; rather, they described observed symptoms in vivid detail and, sometimes, provided what they believed to be the underlying medical condition. We do not attempt to resolve discrepancies arising from the inexactness associated with the reporting of symptoms. If, for example, a veteran had a cardiovascular problem that entitled him to a pension, a change in the severity of his condition or the presence of a new condition entitled him to an increase in pension amount. In each case, the veteran had to be examined by a pension board surgeon to confirm a change in health status. We have not attempted to deal with the problem of increasing severity. Our analysis assumes the existence of a condition from the first examination that results in a rating for that condition.

There is support for the idea that what ailed veterans is what killed them. In the aggregate, of the 8,332 veterans in our sample, 96.4% of them were diagnosed with one or more of the 20 chronic conditions that qualified them for a pension; the average number of diagnosed conditions was 4.7. In 44.7% of the cases, a diagnosed condition was listed as a cause of death, and in 51.2% of the cases, a diagnosed condition was listed as either the cause or a contributing cause of death.

³Because the examining surgeons were not allowed to treat the veterans, it is unlikely that there are many examples of such surgeons being a veteran’s personal physician. The surgeons were appointed by the Bureau of Pensions, whose appointments were likely subject to the usual outside influences.

2. Context

The Union Army (UA) database consists of the military, pension, census and lifetime medical records of 35,570 white men from 25 northern states who served as infantrymen in 331 companies in the Union Army during the U.S. Civil War. The data were collected under the auspices of Robert Fogel's Early Indicators of Later Work Levels, Disease, and Death project at the University of Chicago Booth School of Business' Center for Population Economics (CPE).⁴ The database has been shown to be representative of white northern men who served in the Civil War, and more generally, of white northern men who became adults during the 1860s (Fogel and Costa 1997).

Over 85% of the UA sample survived the war; the rest succumbed to injury or disease.⁵ In the years between 1861 and 1890, veterans who were wounded or who experienced chronic aftereffects of wartime disease exposure were entitled to pensions in amounts related to the severity of their injuries. In the present study, we refer to these pre-1890 pensioners collectively as "the injured." The "uninjured"—those who escaped the war without long-term sequelae (a pathological condition occurring as the result of a previous disease) of disease and injury exposure—were only admitted to the pension system after an 1890 act of Congress extended the UA pension to all veterans with any verifiable chronic health condition, regardless of cause (exceptions were chronic diseases resulting from "vicious habits," such as sexually transmitted diseases and those related to alcohol consumption, which were not pensionable).

2.1 Pension History and the Pension Data

All new pensions and changes to existing pensions required an examination by a surgeons' board located in the applicant veteran's county or congressional district.⁶ These surgeons' boards were each comprised of three politically appointed, trained physicians who, despite the primitiveness of diagnostic techniques and the unavailability of effective treatments for most chronic diseases, were nevertheless thorough examiners and vivid describers of any physical abnormality they could see, feel, smell, or, in extreme cases, taste.

In the UA database, these records are coded and classified according to a nosology (a classification of diseases) similar to ICD-9, with 20 general classifications (see Table 1). The records of these examinations and the surgeons' recommendations were forwarded to the U.S. Bureau of Pensions for a ruling on pension amount, which was often around \$12 to \$18 per month, receivable in person at the post office closest to the veteran's home address.

Pension eligibility was further liberalized by administrative rule in 1904, extending the pension to those who were "disabled by reason of age." In 1907, the pension was fully extended to all veterans over 62 years of age. By 1912, the UA pension payments were increased on a graduated basis, with older pensioners receiving larger pensions (Glasson, 1918).

Pension applicants could apply under whatever law they thought would be most lucrative. Therefore, sick people generally applied under the 1890 law, which for full disability or blindness paid up to \$50; veterans who were simply old applied under the 1907 law, which awarded 62-year-olds \$12 and 72-year-olds \$15 per month. These incentives serve our purposes now by insuring that sick people generally were examined by surgeons to verify

⁴The data is available at <http://www.cpe.uchicago.edu>

⁵This is not affected by the recent upward revision of the Civil War death count by David Hacker (2011). Over 85% of the recruits in the sampled companies were discharged alive (or mustered out).

⁶Such examinations were required only when a veteran sought a pension or a change in his pension; they were not annual.

their disabilities and that well people, or people who didn't believe they were ill, applied under the age rule.

Pensions could be inherited upon proof of death cause and date by 1) parents of unmarried soldiers killed in action; 2) minor dependents of veterans who died during or after the war; and 3) widows of pensioners who died during or after the war. Successors to veterans' pensions provided death certificates, death notices, sworn affidavits, and other registers to prove the death cause and date of their veterans, and these records ended up in the veterans' pension files (and subsequently in the UA database). Pensioners without successor applicants might still have a death date since the Pension Bureau usually could cease payment only with proof of a veteran's death.

In the UA database, death causes have been coded and classified according to the same nosology used to categorize the diseases on the surgeons' certificates. For example, a soldier who was diagnosed with an arrhythmia and who died of congestive heart failure would be coded as having a cardiovascular condition and having died of a cardiovascular condition. About 71% of Union Army soldiers were represented in the pension system, either because they were qualified under a relevant statute or because they had a successor who applied on their behalf. Only about 60% were admitted to the pension system as invalids; 51% have surgeons' certificates. A not-entirely overlapping 52% have a death cause. For this paper, we care most about the death cause and disease history. And so, even though the data contain some 15,387 death causes, fewer than 8,400 have both a medical history and a death cause. Death causes favor those who died during service (those lacking a medical history); those with widows or successors; and those who were still living in 1907 (i.e., the healthy).

About 43% of those who were admitted to the pension system came in after 1890. Less than 1% came into the pension system after 1907. Ten percent died before 1890 and 30% died before 1900. Over half our sample was dead by 1920, and nearly all were gone by 1930 when the cohort of men who were in the Union Army would have been in their early 90s. Cain and Hong (2009) have examined causal factors in this precipitous die-off in detail. In the present study, we are not concerned with the timing of the deaths as much as we are with why men in that cohort died. As noted, we use a subsample of 8,332 UA men who were pensioners, who had surgeons' certificates and both a recorded date of death and a death cause or contributing cause. This subsample was then divided into pre-1890 and post-1890 pensioners—the “injured,” and the “uninjured.”⁷

2.2 Data Limitations

Using the UA data is difficult, not only because of certain biases that may be present, but also because it requires users to make certain assumptions about both the meaning of surgeons' certificates and about the relevance of medical history.

The inputting of the surgeons' data and the death-cause data was designed, supervised, reviewed, and corrected by medical doctors at the CPE (Wimmer, 2003).⁸ Medical doctors also coded the disease descriptions by the pension surgeons to reflect signs and symptoms of chronic disease. These are not diagnoses that require a more holistic approach, where each soldier's entire medical history would be examined to determine underlying conditions related to the symptoms reported. Because of the expense of that approach, the CPE doctors

⁷There is a possibility the lack of examination or death information introduces sample bias, but it's direction is not clear. Only veterans with examination information and a date of death and a death cause were included in the sample; 27,128 veterans in the UA data were excluded as a result of a missing date of death, death cause, and/or examination information. This latter group was a bit older (born 1837 vs. 1838), died younger (1891 vs. 1909) as many died during the war, was slightly more urban (8.7% vs. 7.8%), and was more or less the same height (67.5 vs. 67.6 inches).

⁸See also Henderson (2005) and Linares and Su (2005).

simply coded the symptoms separately without regard to comorbidities. This is a reasonable approach in most cases. However, sometimes this presents problems. Consider a case where a veteran is observed with what the surgeons call “chronic diarrhea” and that he is also observed with “blindness.” CPE doctors coded chronic diarrhea and blindness as separate conditions, unless the pension surgeons had noted that they thought the two conditions were related, in which case the CPE doctors would note the relationship. Consider another case where a veteran is observed with “pneumonia,” “disease of heart,” and “failure of kidneys,” which many would diagnose as “congestive heart failure.” Unless the pension surgeons noted “congestive heart failure” on the surgeons’ certificate, CPE doctors did not make such determinations. CPE doctors took the symptoms supplied and coded them as conditions of lungs, kidneys, and heart; the three were assumed to be independent of one another. So, if the soldier ended up dying of pneumonia, it was coded as a lung-related (pulmonary) death rather than a cardiovascular death.⁹ Modern death-cause data have similar problems, but modern medical histories contain diagnoses, whereas the UA database does not. For this reason, without additional work by medical doctors, we cannot make diagnostic determinations about the chronic disease causes of death. We can only talk about correlations between comorbidities and death causes.

The data contain information on multiple causes and contributing causes of death. We used MICAR/SUPERMICAR/ACME software provided by the Centers for Disease Control for use in coding diseases and death causes in the modern healthcare industry to determine which of the multiple causes was the most plausible. We then used that cause (and the most probable contributing cause) in our analyses. To the extent that this approach drops what the software considers to be causes that are implausible, it limits the amount of information we really have concerning a veteran’s death. The software also limits us to the extent that historical death causes are less reflective of the current understanding of medical conditions. For example, many soldiers died of yellow, green, or red “softening.” This is thought to be indicative of different types of hemorrhage or possibly of different stages of one type of hemorrhage. Our analysis is limited to the extent that this distinction matters one way or the other; we code this as “hemorrhage” and assume that the color modifiers are not significant. There are other such cases where historical terms for infectious illness require that we generalize the death cause more than modern medical studies would do. Without holistic analysis of individual health histories, general death causes are the best we can do.¹⁰

Finally, as noted, pension surgeons were legally prohibited from treating the medical conditions they observed and were legally required to substantiate that the conditions they noted were chronic, as opposed to acute, ailments. For our study, this means that we will lack information about the buildup of conditions that are acute unless those conditions result in death, in which case it would show up as a death cause. On the other hand, if an acute condition has long-term sequelae, it would be noted by the surgeons. For example, if an acute infection leaves a soldier with chronic bronchitis, the bronchitis will be noted, but its infectious origin will not. So, our analysis will be able to say something about the buildup of conditions that are rated by surgeons to be disabling, but it will say nothing about the effects of repeated exposure to infections and other acute, episodic conditions, except as those effects are related to detectable scars or sequelae (i.e., we won’t know about a gunshot wound in 1885, but we will know every imaginable thing about the scar tissue it leaves behind).

⁹Pneumonia is an opportunistic infection from which sickly people frequently die rather than from the illness that causes the onslaught of pneumonia. So, the old man’s “friend” or “blessing” should have made pulmonary infections a prominent death cause.

¹⁰CPE doctors plan to develop appropriate algorithms for determining probable disease diagnoses based on the surgeons’ data in the near future.

2.3 The Literature

The UA pension period (1860–1930) saw a secular decline in acute infection as a death cause and an increase in chronic disease (e.g., cardiovascular disease). Among many causes was the reduction in waterborne disease attributable to an improvement in sanitation.¹¹ One manifestation of the decline in infections was that male infant mortality rates (IMR) declined rapidly (Drevenstedt et al. 2008). Fogel (2004) observed an 84% decline in urban IMRs between the healthiest and least healthy cities between 1890 and 1920, so that by 1930 the reduction in disparity was nearly equal to the reduction in the overall IMR. Other research has equated these declines in IMRs to declines in infant disease exposure, which resulted in reduced mortality at later ages (Fogel and Costa, 1997; Deaton, 2003; Deaton, 2005).

Costa (2000 and 2002) found that cardiovascular conditions in the 19th century were mostly the long-term sequelae of acute infectious disease exposure, as opposed to ischemic heart disease. Also, these scarring effects of acute disease exposure are important indicators of lifetime disability and mortality declines since the UA pension period.¹² Chronic “scars” of acute disease exposure have been found to reduce life span below the expected level throughout the 19th century (Catalano and Bruckner, 2006).

These and other findings on chronic disease and mortality point to the mortality or health transition in the 19th century—that as the infectious environment improved, later life disability and chronic conditions would have been more important as causes of death. This also implies that a population with reduced acute disease-related death would have higher levels of chronic disease at every age.

Riley (2001) argued that health transitions happen for a variety of causes, some of which are related to the type of conditions, some of which are more related to comorbidity (Riley, 2001). In addition to the decline in infectious diseases, the UA period also saw a reduction in deaths by infectious causes, even where infection rates remained high (Bengtsson, 1998). If chronic diseases are assumed to accumulate throughout the life course and early-life exposure to insults results in later-life chronic disease, it is of secondary importance whether the cause of death was acute or chronic (Alter and Riley, 1989).¹³ Riley argues that mortality will be more likely to result from each acquisition of a chronic condition. So, in essence: the most important condition, in terms of mortality, is your next condition, not the chronic conditions you now have.

In subsequent sections of this paper, we present limited evidence for both views: first, that the long-term effects of chronic illness are important in predicting death cause; and second, that an insult, or the interaction between old insults and a newly acquired insult—a soldier’s next acquired insult, whether acute or infectious—is a plausible predictor of death cause.

3. Data

There were persistent (and possibly important) differences in the timing of the onset of a ratable condition between the surviving injured and uninjured veterans. The injured could have been diagnosed with conditions for more than two decades before the uninjured

¹¹See, for example, Cain and Rotella (2008), Cutler and Miller (2005), and Troesken (2004), among others.

¹²Both papers discuss how chronic disease changed over the 20th century. The UA sample provides the best evidence of morbidity for the cohort born c.1840, and in these papers Costa compares chronic conditions among Civil War veterans with what can be found in the 1988–1994 National Health and Nutritional Examination Survey (NHANES) and from the 1994 and 1995 National Health Interview Surveys (NHIS). It is unlikely that chronic conditions were “underdiagnosed” among those receiving a Union Army pension as a medical examination was a requirement for receiving a pension. We do not know the condition of those who did not apply for a pension.

¹³See also Fogel (2004), Costa (1997), and Costa (2002).

became eligible for a pension. Table 2 shows how much more or less likely injured veterans were rated with each specific condition listed in Table 1 at each of the first three examinations after 1890. Each observation is the ratio of the percentage of the injured rated with a specific condition to the percentage of the uninjured with that condition. The first column shows the head start the injured had over the uninjured. For example, there were 47% more of the injured than uninjured with a cardiovascular condition after the first examination. This column reflects both the stock of conditions within the injured population and the additional conditions with which both the injured and uninjured were diagnosed at the first visit after 1890. While the injured reach 1890 with previously rated conditions, at that first visit after 1890, the uninjured were being diagnosed with new conditions at a greater rate than were the injured. The second and third exams show that the uninjured were catching up to the injured in terms of the number and type of rated conditions. Thus, by the third examination after 1890 only 13% more of the injured were diagnosed with a cardiovascular condition than the uninjured. On average, and this is not part of a table, the injured were diagnosed with a little less than one-half more conditions before death than the uninjured (4.9 v. 4.5). This was due in part to the fact that 43.7% of injured veterans were rated for wounds as opposed to only 27.0% of uninjured.

With respect to the data on death causes, Table 3 shows the average age at which injured and uninjured veterans died by the number of conditions with which they were diagnosed prior to death. On average, the uninjured veterans lived roughly four years longer, but a good deal of this difference likely is attributable to injured veterans being able to enter the pension system before 1890. In fact, about 15% of the injured veterans receiving a pension had died before the uninjured veterans were eligible for one.

Next, we evaluate the specific causes of death, which we have coded according to the same nosology used for the chronic conditions in the pension surgeons' data. The distribution of death by cause for the injured and uninjured together is indicated in Table 4. Only those causes responsible for 5% or more of the deaths are listed, and they account for over 80% of the total deaths. We will focus our analysis on this subset of six causes.¹⁴ The table also reports data cause data from the 1910 Census on males 65–74 years of age in the Death Registration Area. The data suggest veterans were more likely to die of a cardiovascular condition and less likely to die of an infectious disease than the population as a whole. Given these veterans potentially received much more medical attention than others in the population, it may have been the case that the cause of death could be more accurately determined.

The disease histories of the injured and uninjured were similar. Table 5 gives the percentage of veterans who were diagnosed with the above conditions by their first and second examinations after 1890. These are the percentages that underlie the ratios presented in Table 2. Given the injured have had many more visits with the surgeon (due to their early pension eligibility), the second visit after 1890 provides a more appropriate comparison in terms of both a veteran's age and examination timing. While the table shows a difference between injured and uninjured after the first visit, a chi-squared test of the percentages for the second visit cannot reject the null hypothesis that the percentages are equal between the two groups.¹⁵

¹⁴The small sample sizes of the remaining 14 causes of death preclude meaningful statistical analysis.

¹⁵Table 5 is a simple comparison of counts; it does not control for things like age. Such controls are part of the analysis later in this essay. It also should be noted that height is not used. Its inclusion at the time of enlistment in the regressions of Cain and Hong (2009) proved of little consequence, and, since the same data are used here, height was omitted from this analysis. The absence of scales at enlistment meant BMI could not be calculated.

As shown in Table 6, for conditions such as tumors and genito-urinary, the age at death was similar for the two groups. For the others, the injured died three to five years earlier, or nine years earlier when an infectious disease was involved. It seems likely that the wound that led to admission in the pension prior to 1890 created a greater susceptibility to infectious diseases, and more deaths were attributed to infectious diseases before 1890.

4. Ailments and Death Causes

The next step is to examine the link between rated conditions and death causes. We concentrate on the six death causes responsible for at least 5% of the deaths as reported in Table 4.

4.1 Nosological Concerns

While the nosology is the same for rated conditions and death causes, reality can be quite different. The typical cardiovascular conditions that qualify a veteran for a pension include indications of valvular disease, myocarditis and hypertrophy, and atherosclerosis; all that may have been reported by the surgeon, however, is “disease of heart.” Typical death causes recorded as attributable to cardiovascular conditions include “heart disease chronic,” valvular damage, arteriosclerosis, hemorrhage, stroke, indicators of chronic congestive heart failure, and “disease of heart.”

Pulmonary conditions are neither as clear nor as related. What typically appears on the surgeons’ certificates are conditions such as lung disease, catarrh, congestion, and bronchitis of various types. The death certificates are dominated by pneumonia of various types (including many that are assumed in ICD guidelines to be acute), embolisms, and bronchitis. Clearly, pneumonia may result when a body is no longer able to cope with other conditions, but if it appeared on the death certificate (and it commonly did so), it was recorded as a pulmonary condition.¹⁶

Gastrointestinal conditions often contained the words “chronic diarrhea.” It was not the “chronic diarrhea” that today is associated with the death of people who have weakened immune systems. Most likely the term indicated a persistent, episodic (acute) tropical gastroenteritis. Similar wording appeared on death certificates as well as congestion, tubercular infections, and intestinal conditions likely related to infectious disease.

The genito-urinary (kidney) problem listed on the surgeons’ certificates was almost always chronic kidney disease. The death certificates were more detailed and included uremia, nephritis, Bright’s and Addison’s disease, prostate conditions, and cystitis. Two-thirds of “acute” designations on death certificates are genito-urinary conditions.

The infectious diseases that qualified one for a pension are largely malaria and tuberculosis, plus chronic sequelae of infection. Malaria and tuberculosis are the two chronic infectious diseases found on death certificates, but acute infectious conditions are even more likely to appear as a cause of death.

Finally, tumors were extremely difficult to identify in these years when examination was limited to what you could see with a magnifying glass, hear through a stethoscope, feel, or smell. While an autopsy would make it possible to identify when death was attributable to a tumor, autopsies were not normally performed on the veterans in order to determine a death cause.

¹⁶We are unable to tell if this is viral or bacterial pneumonia.

4.2 Cardiovascular

We begin with cardiovascular disease, which was the most frequent cause or contributing cause of death in our sample, appearing on 43.9% of all certificates.¹⁷ For those who were rated for a cardiovascular condition, Table 7 reports the frequency distribution of causes of death. The frequency among the injured is basically similar to that of the uninjured, and once again a chi-squared test is unable to reject the hypothesis that this is the case.¹⁸

Roughly two-fifths of those with a rated cardiovascular condition had a cardiovascular condition listed as a cause of death. An additional one-fourth had either a pulmonary or genito-urinary condition listed as the cause of death; recall that individuals can be rated with multiple conditions. The rest is split between a variety of causes including tumors, which only accounted for only 5–6% of the cases. As noted earlier, this is probably an underestimate based on the limitations of diagnosis at the turn of the 20th century.

In Table 8, we look at the inverse of Table 7, the conditions with which veterans who died of a cardiovascular condition were rated. As in Table 7, a chi-squared test cannot reject the hypothesis that the two sets of proportions are equal. Almost two-thirds of those who died of a cardiovascular condition had been rated for one, but almost a third had been rated with a pulmonary condition, and almost half of the injured with a gastrointestinal condition.

There were several specific conditions that fell under the rubric “cardiovascular.” Table 9 reports the frequency distribution of these specific conditions for those who were rated for cardiovascular. We know the type of cardiovascular condition for which each veteran was rated(and he could have had multiple ratings, but, in general, if he died of a cardiovascular condition, we don’t know the type from which he died.

Where a cardiovascular condition was listed as a cause or contributing cause of death (see Table 10), the differences between the injured and uninjured were relatively small, both with respect to the age at which they were first diagnosed and the number of years they lived after the diagnosis with the exception of the before-50 age group when many of the uninjured would have been ineligible for a pension. The relatively wide difference in mean life after diagnosis is attributable to the fact that the uninjured diagnosed before their 50th birthday were relatively close to 50; their average birth year was approximately 1840. An 18-year old who enlisted in 1864 could have been diagnosed in his 30s if injured, but not until his mid-40s if uninjured.

4.3 The Other Five Death Causes

Given that 43.2% of those rated with a cardiovascular condition had such a condition listed as a cause of their death (50.0% if contributing causes are included), there might be some evidence that what ail’d ya was indeed what kill’d ya’. That impression changes in Table 11, which is identical to Table 8 for the other five death causes of death. With two exceptions, a larger percentage of veterans was rated for a cardiovascular condition than for the condition on their death certificate. Those two exceptions are, first, the uninjured veterans who died of a gastrointestinal condition (where 35.0% were rated with a gastrointestinal condition vs. 25.9% who were rated with a cardiovascular condition). The uninjured who died of a gastrointestinal condition are the only group in Table 11 where the condition on their death certificate was the condition with which the largest share of the deceased was rated. The second exception is the injured veterans who died of an infectious disease, where 39.8%

¹⁷This is the sum of the 37.8% reported in Table 4 for primary cause of death and an additional 6.1% where it is listed as a contributing cause.

¹⁸The test compares injured vs. uninjured for all causes together. While cardiovascular has the largest absolute difference (with the exception of “other”), the percentage differences are larger for gastrointestinal, genito-urinary, and tumor (as well as other).

were rated with a pulmonary condition vs. 37.7% with a cardiovascular condition and only 15.9% with an infectious disease.

For the injured who died of a gastrointestinal condition, both a cardiovascular (51.1%) and a pulmonary condition (30.7%) were rated more often than a gastrointestinal condition (29.8%). For the uninjured, the ranking was gastrointestinal (35.0%), pulmonary (33.8%), and then cardiovascular (25.9%). For those who died of a genito-urinary condition or tumors, whether injured or uninjured, more were rated with cardiovascular, pulmonary, and gastrointestinal conditions than with either a genito-urinary condition or a tumor. Those three were also more common for those who died of infectious diseases with some variation in the order, as the second exception testifies. For those who died of a pulmonary condition, cardiovascular conditions are rated at a higher percentage, with pulmonary second and gastrointestinal third.

5. Analysis

We use a pooled logistic regression model for the discrete time hazard of death using the death certificates in the Union Army data.¹⁹ We adopt 1890 as the baseline; the regressions include only those (injured and uninjured) veterans who were alive in 1890. Initially, the group is the 8,332 defined above, but our statistical approach requires that we eliminate the veterans for which there was only a single visit to a surgeon. This means that the effective sample size was reduced further to 7,544.

We began by examining those who died of the six particular conditions (cardiovascular, pulmonary, genito-urinary, gastro-intestinal, infectious disease, and tumor) that each were responsible for at least 5% of the veterans' deaths. We only consider the reported cause of death; we did not include contributing causes in this analysis. In these regressions, the dependent variable is a time-dependent indicator for having died of a particular condition (equal to 1 if the veteran died of that condition or equal to 0 if the veteran was alive, censored, or died of another cause that year). In each regression, we include an indicator for whether a veteran was rated for one of the twenty specific conditions that would have made him pensionable (equal to 1 if rated or equal to 0 otherwise). Controls are included for an urban birthplace (equal to 1 if born in one of the top 100 urban places based on population size in the 1860 Census or a foreign birthplace and equal to 0 for those born in rural areas of the U.S.), and their age in 1840 (the median birth year of veterans at baseline).²⁰ We include a variable for whether they were injured (equal to 1 if they were in the pension before 1890 and equal to 0 otherwise) and an interaction term between injured and whether or not they had received a rating for the condition listed as their cause of death. In addition, a linear time trend is included in each regression.²¹

Table 12 reports the hazard ratios for dying from a condition given that you had that condition (the "own" relationship) and the other variables discussed above.²² In the top panel, the results for the six conditions are grouped, and the hazard ratios for cause-specific

¹⁹There are well-defined problems that emerge when this specification is used with a fixed population. Each group has a survivor rate of 1 at the start, and they each have a rate of 0 by some year.

²⁰See Cain and Hong (2009) for more on the hazard of urban life among these veterans. One also can think of this variable as a dummy dividing the veterans into those from rural areas in the U.S. and others. As Cain and Hong demonstrates, the hazard ratio for those born in U.S. urban areas is close to those born outside the U.S.. Residence in 1860 was excluded because it would significantly reduce the sample size. Residence at death was excluded as the urban mortality penalty was clearly apparent from the birthplace information, and its inclusion would also reduce sample sizes.

²¹Alternative specifications of the time trend were estimated, but standard statistical tests led to the conclusion that a parsimonious linear specification was all that was necessary. We also explored whether having been rated for a cardiovascular condition modified the effect of each of the other five conditions on cause-specific mortality, but an interaction term between having been rated for that condition and having been rated for a cardiovascular condition did not add any explanatory power.

mortality appear on the principal diagonal of this panel. Those with probabilities of 0.05 or less have been bolded, as is true in the other panels as well. The middle panel reports the ratios for the other fourteen conditions, while the bottom panel reports the results for the control variables. It should be noted that the coefficient on the interaction term is not statistically significant at conventional test levels in all regressions except the one for those who died of gastro-intestinal problems. For the five regressions where this term is not statistically significant, it is reasonable to look at a regression that combines the injured and the uninjured. This is not true for those who died of a gastro-intestinal condition.²³

Looking across that principal diagonal in the top panel, a veteran's hazard of dying from a cardiovascular condition increases by 25% if he had been rated with such a condition. The hazard of dying from a pulmonary or genito-urinary condition increases by nearly 60% if such a condition had been rated. This is almost the same increase as for a gastro-intestinal condition, but this is the condition that gave rise to the first exception in Table 11, thus the injured and uninjured need to be considered separately (such regressions are not reported here). The hazard ratio for the injured is just under 0.8 and is statistically significant; whereas for the uninjured it is over 2.00, but not statistically significant. This suggests there may be important differences between the form gastro-intestinal conditions took between the two groups. For tumors, the hazard increases by a factor of four. For infectious diseases, the ratio increases by 15%, an increase that is not considered to be statistically significant.

The hazard ratio for death due to a cardiovascular condition was less for those rated for a pulmonary condition and higher for those with a poor general appearance and varicose veins. For deaths from a pulmonary condition, the hazard was less for a veteran with a gastrointestinal, ear or rheumatism/musculo-skeletal condition, while it increased for those with a gall bladder condition. For those who died from genito-urinary conditions, rheumatism was associated with a reduced hazard, while varicose veins were associated with an increase. The hazard of dying from a gastro-intestinal condition actually was less for those rated with that condition, but liver, genito-urinary, and gall bladder conditions were all associated with an increased hazard of dying from a gastro-intestinal condition. The hazard ratio of dying from an infectious disease was higher for those with a pulmonary condition and lower for those with an ear condition. A nervous condition was associated with a reduced hazard of dying from a tumor.

For the hazard of dying with a gastro-intestinal condition, the combined regression suggests that the hazard ratio was higher if a hernia or gall bladder condition was present. Looking at the separate regressions, no other condition has a statistically significant effect on the hazard ratio for the uninjured, but a genito-urinary, liver, or (particularly) gall bladder condition generally is associated with an increased hazard. Once again, the difference between the two groups requires more study.

The hazard ratio increases at approximately 8% a year for all the conditions that killed these veterans except infectious disease; fatal infections could strike veterans at any age. Having been born in an urban area increases the hazard ratio for deaths attributed to cardiovascular, pulmonary or tumor conditions.

²²We are assuming that, before 1890, the mortality experience of the injured and the uninjured were identical. If our assumption is not true, the estimates in our analysis are biased. To assess the direction of the bias, we need information on both the distributions of the exposure and the outcome; we have neither.

²³It should be recalled that, when 100 hazard rates are estimated, chance alone would lead to 5 being statistically significantly different from 1 at the 95% level. In particular, there are 84 hazard ratios for the non-top-6 diseases and 10 of them are statistically significant at the 95% level; chance alone would predict about 4.

For these regressions, unexpected associations between disease conditions and death causes present areas for future testing and research. Several unexpected associations might be explicable as artifacts of the UA database and the examination schedule and procedures or as a representation of an actual medical relationship between the condition and death.

We briefly turn to the Riley-Alter insult hypothesis.²⁴ Table 4 provides some support for the insult hypothesis. It is clear that, the longer a veteran lived, the more likely he was to be rated for additional conditions, but the increment to the age at death decreases for each additional condition. In Table 13 this hypothesis is examined with the specific ratable conditions established by the pension board. This regression does not include all the insults the Riley and Alter would require because we lack that information. While this omits childhood and young adult insults, it includes most of the major older adult ones. In particular, in these data, the dependent variable is the number of deaths occurring in a year. The independent variable “numconds” is the total number of unique rated conditions for each veteran each year beginning in 1890. We also included an interaction term between the number of conditions and number of injured (those in the pension system before 1890) to determine if we could view the veterans as a single population. The model includes a linear time trend, their age in 1840, and an indicator for whether they had an urban-foreign birth place.

The results indicate that for each additional condition with which a veteran was rated, the hazard ratio increased by 1.8%. There was no statistically significant difference between those who entered the pension system before 1890 and those who entered later. Being born in an urban area increases the hazard, as does each year of age.

6. Discussion

First, within-cause or within-condition heterogeneity makes it difficult to determine if a particular relationship ought to be expected. For example, the hazard of death by genito-urinary condition appears to be higher if varicose veins are also present. Genito-urinary conditions causing death ranged from nephritis (inflammation of the kidneys) to hepatitis to pancreatic cancer. And within each of those deadly conditions, there is also variation. For example, while nephritis and varicose veins might both be symptoms of a cardiovascular condition, nephritis had other causes, including infection.

Second, a protective condition might simply be one that is so severe that it protects against death by any condition but itself (or a related condition). Consider the protection against death by tumor offered by nervous conditions. This might indicate simply that brain injuries and brain infections are more likely to cause death than even an extremely advanced tumor.

Third, unexpected relationships between disease conditions and causes of death might be a result of the differential detectability of specific diseases. Some diseases, like arteriosclerosis, stroke, and tumor, were not detectable by surgeons until they reached extreme severity. The presence of these conditions might have indicated a higher hazard of death by certain conditions, or a higher hazard of contracting an acute condition leading to death. Conversely, the presence of rheumatism was easy to observe (it only required the presence of pain or tenderness in the joints and muscles) and was nearly ubiquitous at older ages. Its positive association with age might merely indicate the veterans’ hardiness as much as anything else. Also, easily detectable conditions that were more likely to strike younger men, such as wounds, hernias, and hemorrhoids that were the result of wartime experience, might simply be chronic, non-deadly conditions that indicate a soldier’s ability to survive.

²⁴See Riley (1989) and Riley and Alter (1989).

Fourth, uninjured soldiers could have been protected against death by infectious causes from previous exposure to an infectious disease. This might be a medically verifiable relationship, whereby a veteran gained immunity to future infectious conditions because of his wartime experiences in the camps or because he was born in an urban area where the infectious disease environment was much different than in a rural area. Also, there is the now known association between infectious diseases and chronic conditions and tumors.

Finally, differences in the chronicity of diseases and death causes might underlie unexpected associations between them. Gastro-intestinal conditions tended to be protective against death. This may be simply that the gastro-intestinal conditions noted on surgeons' certificates were not deadly conditions and didn't increase a soldier's hazard of contracting a deadly gastro-intestinal condition, but that they were more likely to weaken his system in other ways. For example, mild, tropical enteritis need not be a harbinger of death by stomach ulcer or of chronic diarrhea of infectious origin, but it might indicate imminent death by another less immediate cause.

7. Conclusion

In sum, we return to the question: was what ail'd ya' what kill'd ya'? In general, once a veteran was rated for a particular condition, his hazard of dying from that condition increased. All the coefficients on the principal diagonal of Table 12 are greater than one, and all save that for infectious diseases are statistically significantly greater than one at the 95% level of confidence.

Why this is so requires further research. All these associations, both expected and unexpected, will be the subject of future work with the Union Army database that will require the analysis of more disaggregated disease and death variables than are currently publicly available.

Acknowledgments

This work was supported in part by NIH program project grant P01 AG10120.

References

- Alter G, Riley JC. Frailty, Sickness, and Death: Models of Morbidity and Mortality in Historical Populations. *Population Studies*. 1989; 43:25–45. [PubMed: 11622025]
- Barker, DJP. *Fetal and Infant Origins of Adult Disease*. London: British Medical Journal Publishing Group; 1992.
- Barker, DJP. *Mothers, Babies, and Disease in Later Life*. London: British Medical Journal Publishing Group; 1994.
- Bengtsson, T. The great mortality decline: Its causes and consequences. In: Nuñez, C-E., editor. *Debates and Controversies in Economic History*. Madrid: Fundación Ramon Areces e Fundación Fomento de la Historia Económica; 1998. p. 84-99.
- Bureau of the Census. *Mortality statistics 1910: Eleventh Annual Report*. Washington, DC: Government Printing Office; 1913. p. 348-359.
- Cain LP, Hong SC. Survival in 19th century cities: The larger the city, the smaller your chances. *Explor. Econ. Hist.* 2009; 46:450–463. [PubMed: 20161075]
- Cain, LP.; Rotella, E. Epidemics, demonstration effects, and municipal investment in sanitation capital. In: Rosenbloom, J., editor. *Quantitative Economic History: The Good of Counting*. New York: Routledge; 2008. p. 34-53.
- Catalano R, Bruckner T. Child mortality and cohort life span: A test of diminished entelechy. *Int. J. Epidemiol.* 2006; 35:1264–1269. [PubMed: 16723366]

- Costa DL. Displacing the family: Union Army pensions and elderly living arrangements. *J. Polit. Econ.* 1997; 105:1269–1292.
- Costa, DL. Appendix A: Union Army pensions and Civil War records. In: Costa, DL., editor. *The Evolution of Retirement: An Economic History, 1880–1990*. Chicago: University of Chicago Press; 1998. p. 197–212.
- Costa DL. Understanding the Twentieth Century Decline in Chronic Conditions among Older Men. *Demography*. 2000; 37:53–72. [PubMed: 10748989]
- Costa DL. Changing chronic disease rates and long-term declines in functional limitation among older men. *Demography*. 2002; 39:119–138. [PubMed: 11852833]
- Cutler D, Miller G. The Role of Public Health Improvements in Health Advances: The 20th-century United States. *Demography*. 2005; 42:1–22. [PubMed: 15782893]
- Deaton A. Health, inequality, and economic development. *J. Econ. Lit.* 2003; 41:113–158.
- Deaton A. Measuring poverty in a growing world (or measuring growth in a poor world). *Rev. Econ. Statistics*. 2005; 87:1–19.
- Drevenstedt GL, Crimmins EM, Vasunilashorn S, Finch CE. The rise and fall of excess male infant mortality. *P. Natl. Acad. Sci. USA*. 2008; 105:5016–5021.
- Fogel, RW. *The Escape from Hunger and Premature Death: Europe, America, and the Third World, 1700–2100*. New York: Cambridge University Press; 2004.
- Fogel RW, Costa DL. A theory of techno-physio evolution, with some implications for forecasting population, health care costs, and pension costs. *Demography*. 1997; 34:49–66. [PubMed: 9074831]
- Glasson, WH. *Federal Military Pensions in the United States*. New York: Oxford University Press; 1918.
- Hacker D. A Census-Based Count of the Civil War Dead. *Civil War History*. 2011; 57:307–348. [PubMed: 22512048]
- Henderson RM. The bigger the healthier: Are the limits of BMI risk changing over time? *Econ. Hum. Biol.* 2005; 3:339–366. [PubMed: 16202670]
- Linares C, Su D. Body mass index and health among Union Army veterans: 1891–1905. *Econ. Hum. Biol.* 2005; 3:367–387. [PubMed: 16046203]
- Riley, JC. *Sickness, Recovery and Death: A History and Forecast of Ill Health*. Iowa City: University of Iowa Press; 1989.
- Riley, JC. *Rising Life Expectancy: A Global History*. New York: Cambridge University Press; 2001.
- Riley JC, Alter G. The epidemiological transition and morbidity. *Ann. de Demog. Hist.* 1989:199–213.
- Troesken, W. *Water, Race, and Disease*. Cambridge: MIT Press; 2004.
- Wimmer, LT. Reflections on the “Early Indicators” project: A partial history. In: Costa, DL., editor. *Health and Labor Force Participation over the Life Cycle: Evidence from the Past*. Chicago: University of Chicago Press; 2003. p. 1–10.

Table 1

Ratable Conditions

Condition	Percent	Condition	Percent
Cardiovascular	55.4	Ear diseases	17.7
General appearance	49.6	Liver	17.4
Rheumatism/Musculo-skeleton	49.5	Hernia	17.1
Wound	37.5	Genito-urinary	17.1
Respiratory	33.7	Infectious disease	10.7
Rectum/Hemorrhoids	32.7	Varicose veins	8.9
Nervous System	29.0	Spleen	8.1
Gastro-intestinal	27.0	Tumor (neoplasm)	2.4
Diarrhea	25.3	Endocrine disease (kidney)	1.2
Eye disorder	23.5	Gall bladder	0.5

Note: The percent columns are the percentages of veterans in the sample who received a rating for that condition.

Table 2

Difference between Observed Conditions of Injured and Uninjured Veterans at a given exam after 1890

Condition	Injured during War/Uninjured during War		
	Examinations		
	First	Second ⁺	Third ⁺
Cardiovascular	1.47	1.19	1.13
Diarrhea	2.23	1.79	1.68
Ear diseases	1.34	1.20	1.09
General appearance	1.97	1.37	1.22
Hernia	1.10	1.02	1.05
Infectious disease	2.52	1.81	1.52
Endocrine disease	0.83	0.80	0.91
Liver	2.10	1.55	1.46
Rectum/Hemorrhoids	1.36	1.22	1.18
Nervous system	2.66	2.07	1.55
Respiratory	1.44	1.18	1.08
Gastrointestinal	1.69	1.25	1.22
Rheumatism/Musculo-skeletal	1.06	0.96	0.91
Spleen	1.79	1.51	1.57
Tumor	1.66	1.32	0.98
Genito-urinary	1.58	1.31	1.18
Varicose veins	1.84	1.53	1.19
Wound	2.28	1.83	1.57
Eye disorder	1.32	1.10	1.05
Gallbladder	2.71	1.43	1.95

⁺ Only newly observed conditions are included for the second and third examinations; the first column includes all injured veterans rated before or at that examination.

Table 3

Average Age at Death and Birth Year by Number of Rated Conditions

Number of rated conditions	Injured		Uninjured	
	Age at Death	Birth Year	Age at Death	Birth Year
n	n	n	n	n
0	52.7	1834	207	1840
91			70.1	1840
3	67.2	1837	705	1839
511			72.5	1839
4	69.5	1837	682	1840
453			73.0	1840
5	71.5	1837	613	1840
408			74.5	1840
6	72.6	1837	512	1840
312			74.5	1840
7	73.8	1837	436	1840
230			75.5	1840
8	74.7	1838	318	1840
169			74.5	1840
9	75.4	1837	243	1839
110			75.4	1839
10	75.7	1838	169	1841
67			74.9	1841
Overall avg	69.1	1837	5237	1840
3095			73.2	1840

Table 4

Reported Cause of Death

Cause of death	UA Data		1910 Census	
	Frequency	Percent	Frequency	Percent
Cardiovascular	3153	37.8	13841	25.9
Pulmonary	1062	12.8	5511	10.3
Genito-Urinary	912	11.0	8181	15.3
Gastrointestinal	677	8.1	3320	6.2
Infectious Disease	619	7.4	5367	10.0
Tumor	444	5.3	4337	8.1
Other	1475	17.8	12922	24.2
	8332	100.0	53479	100.0

Note: Deaths of males aged 65–74 from the 1910 Census.

Table 5

Conditions Rated in Two Visits after 1890

	First visit (%)		Second visit (%)	
	Injured	Uninjured	Injured	Uninjured
Cardiovascular	38.6	26.2	52.8	44.5
Infectious disease	10.0	4.0	11.8	6.5
Tumor	1.2	0.7	1.6	1.2
Pulmonary	24.7	17.2	31.0	44.1
Genito-Urinary	8.0	5.0	11.9	9.2
Gastrointestinal	16.7	9.9	24.6	39.8
n	3996	3095	3187	2273

Note: A chi-squared test for equality of percentages with respect to the second visit generates a test statistic of 9.00. Since the figure at the 95% level of confidence for 5 degrees of freedom is 11.07, the hypothesis is accepted.

Table 6

Average Age at Death by Cause of Death

Cause of Death	Injured		Uninjured	
	Age	n	Age	n
Cardiovascular	72.5	1900	75.2	1253
Infectious disease	56.5	434	65.2	185
Tumor	71.8	261	72.6	183
Pulmonary	68.7	665	73.0	397
Genito-Urinary	73.2	532	74.5	380
Gastrointestinal	66.5	322	70.2	127

Table 7

Death Causes for Veterans with a Rated Cardiovascular Condition

Death Cause	Injured (%)	Uninjured (%)
Cardiovascular	36.3	43.0
Infectious disease	5.2	5.3
Tumor	5.0	6.1
Pulmonary	11.9	12.0
Genito-Urinary	10.2	12.9
Gastrointestinal	5.4	3.1
Other	26.0	17.6
	100.0	100.0
n	2851	1769

Note: With the relevant chi-squared value equal to 11.07, the calculated value is 3.23. Therefore, the null hypothesis of equal percentages is accepted.

Table 8

Rated Conditions for Those Whose Death Cause was Cardiovascular

Rated Condition	Injured (%)	Uninjured (%)
Cardiovascular	64.6	60.7
Infectious Disease	12.3	7.8
Tumor	2.5	1.7
Pulmonary	33.7	31.8
Genito-Urinary	17.6	15.1
Gastrointestinal	46.1	25.8
n	2210	1444

Note: With the relevant chi-squared value equal to 11.07, the calculated value is 7.26. Therefore, the null hypothesis of equal percentages is accepted.

Table 9

Percent of Rated for Cardiovascular with a Specified Condition

	Injured (%)	Uninjured (%)	Total (%)
Arteriosclerosis (hardening of the arteries)	14.5	11.1	13.2
Cyanosis (blue coloration of the skin)	33.1	28.7	31.4
Dyspnea (shortness of breath)	55.5	56.0	55.7
Enlarged Heart	67.6	62.0	47.6
Impaired Circulation	7.6	4.6	24.5
Murmur	62.7	56.5	48.9
Edema (fluid accumulation)	30.3	23.3	44.7
n	2851	1769	4620

Table 10

Cardiovascular as a Cause and Contributing Cause of Death

	Age at which first observed (%)		Mean life after diagnosis (years)	
	Injured	Uninjured	Injured	Uninjured
Before 50	22.1	15.1	37.2	27.2
In 50s	23.4	28.0	19.1	20.6
In 60s	15.7	15.2	11.8	11.6
70 and after	3.4	2.5	7.1	6.1
Never rated	35.4	39.3		
n	2210	1444	2210	1444

Table 11

Rated Conditions for Those Whose Death Cause was Other than Cardiovascular

Rated with:	Gastro-Intestinal (%)		Genito-Urinary (%)		Infectious Disease (%)		Pulmonary (%)		Tumor (%)	
	Injured	Uninjured	Injured	Uninjured	Injured	Uninjured	Injured	Uninjured	Injured	Uninjured
Cardiovascular	51.1	25.9	56.1	62.7	37.7	51.0	50.6	53.0	54.1	57.4
Gastrointestinal	29.8	35.0	28.8	26.0	21.3	21.9	23.7	24.9	32.0	27.2
Genito-Urinary	19.9	12.1	25.3	20.8	11.4	14.3	13.0	13.0	12.5	16.9
Infectious Disease	10.6	10.2	13.9	7.7	15.9	10.5	12.2	8.0	12.1	5.6
Pulmonary	30.7	33.8	31.4	32.1	39.8	40.0	45.3	34.6	33.8	33.8
Tumor	1.9	1.3	2.7	3.0	1.0	1.9	1.5	2.1	5.3	9.7
n	423	157	697	504	517	210	849	485	281	195

Table 12

Hazard Ratios for Veterans

Rated with:	Cardiovascular		Pulmonary		Genito-Urinary		Gastro-Intestinal		Infectious Disease		Tumor	
	Ratio	P> z	Ratio	P> z	Ratio	P> z	Ratio	P> z	Ratio	P> z	Ratio	P> z
Cardiovascular	1.250	0.000	1.003	0.966	1.053	0.517	0.796	0.052	0.971	0.789	1.036	0.755
Pulmonary	0.903	0.021	1.582	0.000	0.872	0.087	0.925	0.518	1.633	0.000	0.982	0.869
Genito-Urinary	1.030	0.580	1.032	0.742	1.578	0.001	1.223	0.153	0.994	0.971	0.953	0.744
Gastro-Intestinal	0.982	0.730	0.811	0.029	0.948	0.571	1.544	0.036	0.871	0.377	1.105	0.476
Infectious Disease	0.954	0.460	0.991	0.938	1.156	0.218	1.097	0.584	1.150	0.623	0.978	0.899
Tumor	0.863	0.266	0.775	0.287	1.067	0.754	0.759	0.482	0.524	0.191	4.484	0.000
Diarrhea	1.007	0.904	0.888	0.219	1.013	0.891	1.172	0.274	0.876	0.365	1.011	0.938
Ear	0.977	0.639	0.800	0.013	0.964	0.696	1.135	0.357	0.685	0.017	1.011	0.934
General Appearance	1.107	0.017	1.036	0.625	1.094	0.255	0.847	0.163	1.187	0.107	1.084	0.477
Hernia	0.995	0.918	0.897	0.233	1.107	0.248	1.299	0.039	0.969	0.839	1.106	0.427
Kidney-Endocrine	0.747	0.134	1.016	0.962	0.731	0.403	0.666	0.485	0.641	0.333	0.391	0.195
Liver	0.985	0.808	1.005	0.966	0.951	0.661	1.373	0.061	1.272	0.184	0.949	0.752
Rectum-Hemorrhoids	0.925	0.094	0.973	0.743	0.912	0.283	1.071	0.607	0.854	0.220	1.111	0.399
Nervous	1.082	0.074	1.098	0.227	1.047	0.572	0.993	0.957	1.052	0.694	0.765	0.027
Rheumatism-m/s	1.046	0.290	0.759	0.000	0.843	0.026	0.896	0.322	0.919	0.426	0.875	0.222
Spleen	0.921	0.282	1.041	0.783	0.734	0.058	0.998	0.990	0.895	0.597	0.093	0.719
Varicose Veins	1.249	0.000	1.032	0.797	1.278	0.033	1.139	0.471	0.853	0.434	1.298	0.123
Wounds	0.988	0.780	1.004	0.961	1.053	0.980	1.007	0.952	1.060	0.617	0.946	0.615
Eyes	0.943	0.196	0.960	0.599	1.011	0.899	0.992	0.948	0.990	0.943	0.941	0.610
Gall Bladder	0.611	0.081	2.194	0.029	0.865	0.784	2.631	0.036	1.327	0.692	1.119	0.861
Urban	1.210	0.000	1.326	0.000	1.142	0.090	1.086	0.478	0.989	0.924	1.317	0.011
Age 1840	1.088	0.000	1.105	0.000	1.095	0.000	1.084	0.000	0.998	0.796	1.060	0.000
Injured	1.038	0.542	0.955	0.614	0.959	0.611	1.669	0.000	0.867	0.255	1.130	0.173
Inj × rated death cause	1.129	0.120	1.170	0.249	1.157	0.404	0.612	0.033	1.392	0.320	0.493	0.099
Time	1.102	0.000	1.082	0.000	1.100	0.000	1.054	0.000	0.954	0.000	1.087	0.000
Constant	0.002	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.081	0.000	0.000	0.00
n	167708		167708		167708		167708		167708		167708	

Rated with:	Cardiovascular		Pulmonary		Genito-Urinary		Gastro-Intestinal		Infectious Disease		Tumor	
	Ratio	P> z	Ratio	P> z	Ratio	P> z	Ratio	P> z	Ratio	P> z	Ratio	P> z
Pseudo R ²	0.110		0.069		0.090		0.040		0.065		0.032	

Table 13**"Insults" Regression Result**

	Hazard ratio	z
# of Conditions	1.018	3.18
# of Conditions $\times$ Injured	1.006	1.21
Urban Resident	1.188	6.38
Age in 1840	1.096	45.40
Time	0.084	71.05
Constant	-4.710	-139.98
n	167708	
Pseudo R ²	0.097	