The Prevalence of Chronic Respiratory Disease in the Industrial Era: The United States, 1895-1910

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1. Introduction

A typical Union Army soldier returning home from the war in 1865 returned to a world that was still largely rural, agrarian, and unmechanized. Over three quarters of the population lived either in sparsely populated areas or in towns and villages populated by fewer than 2,500 people. Those veterans who lived to old age were to see dramatic changes over the course of their lives. The modern world, with its new conveniences, crowded living conditions, and accelerated pace, descended rapidly as the twentieth century dawned in America. The growth of manufacturing and commerce in the several decades after the Civil War laid the economic foundations for tremendous improvements in standard of living over the twentieth century. These improvements included not only material gains, but also dramatic increases in life expectancy and general health at all points in the life course.[2]

A largely unresolved question, however, is what was happening to health during the period these changes were taking place. Most inferences on health in the nineteenth century come from trends in adult height, which is a comprehensive measure of the cumulative nutritional intake and disease environment present in childhood. In the mid-nineteenth century, a significant decline occurred in mean height, likely bottoming out between cohorts born from 1850-1870.[3] Height among birth cohorts born after the Civil War increased steadily but did not fully recover until into the twentieth century. Fogel (1986) and Pope (1992) demonstrated a similar pattern in life expectancy. These trends

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[2] Life Expectancy at birth (all races, both sexes) increased from 47.3 in 1900 to 76.5 in 1997 (NCHS, 1999). Evidence is emerging, as well, that age-specific prevalence rates have fallen since the early twentieth century for a variety of chronic illnesses (Costa and Fogel, 1997 and Costa, 2000).

[3] This trend was initially identified in Steckel and Margo (1993) and documented later by Fogel (1996), Komlos (1987) and Steckel (1992), among others.

together imply that although life expectancy rose over the latter part of the century and deaths from infectious diseases such as tuberculosis were falling (Leavitt and Numbers, 1985), the elderly at the turn of the century had a particularly poor nutritional history and, for many of them, had suffered the ravages of the Civil War, including the associated exposure to a infectious disease. Costa (2000) has shown recently that early life exposure to chronic illness had significant impacts on having a variety of chronic illnesses at the turn of the century.

Data on specific conditions and disabilities did not begin to be collected systematically in the United States until the 1950s, with the onset of the National Health Interview Surveys. However, new historical data has recently been collected from the pension records of Civil War veterans that can be used to perform epidemiological analyses of a rich variety of specific health conditions around the turn of the century. These data come from a randomly drawn sample of the Union Army that follows over 35,000 Union Army recruits from early childhood until death, by linking the recruits to Census manuscripts and to the pension files that were maintained by the pension bureau. In these files are over 87,000 detailed medical examination certificates of board-certified physicians who determined the veteran's medical eligibility for pension assistance.[4]

One body system that may have been particularly sensitive to the demographic and economic trends in the latter nineteenth century is the respiratory system. In this paper, I provide a detailed (though by no means comprehensive) analysis of the medical data on the respiratory system covering the period 1895-1910. I explore the variety of respiratory conditions that the examining physicians identified, and how the distribution of conditions varied by age, occupation, population and place of birth at four points in

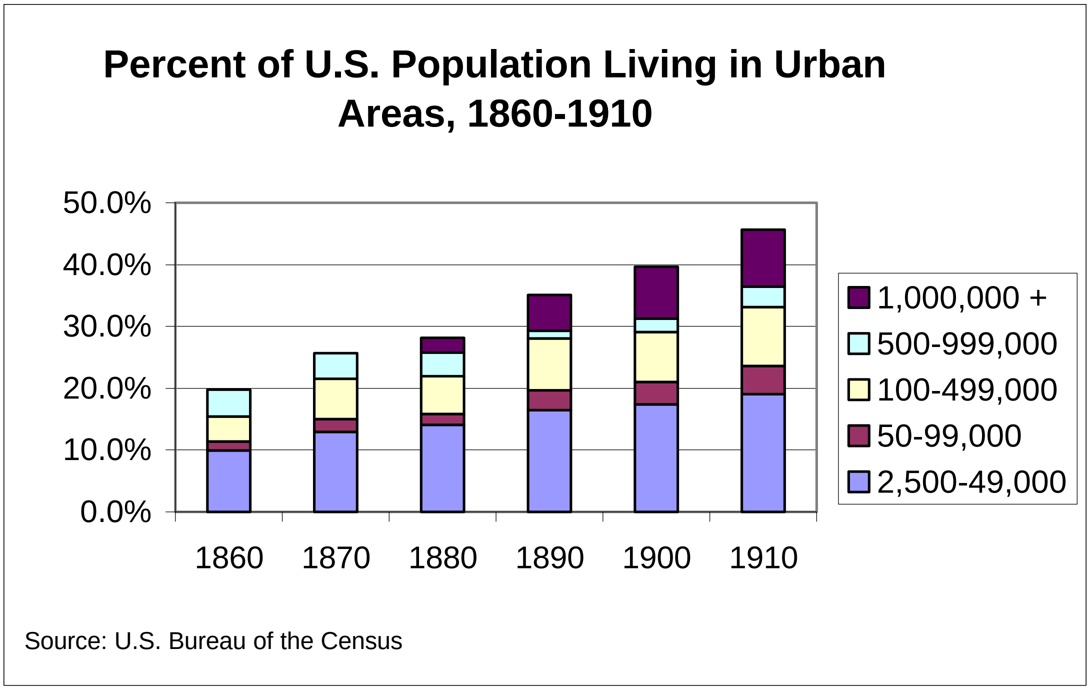
[4] All data used in this study come from Fogel (1999).

time: 1895, 1900, 1905 and 1910. A system-based approach is very practical when using the pension data, since the examining physicians typically recorded their observations system-by-system and recommended financial compensation by body system as well.

2. The Historical Setting

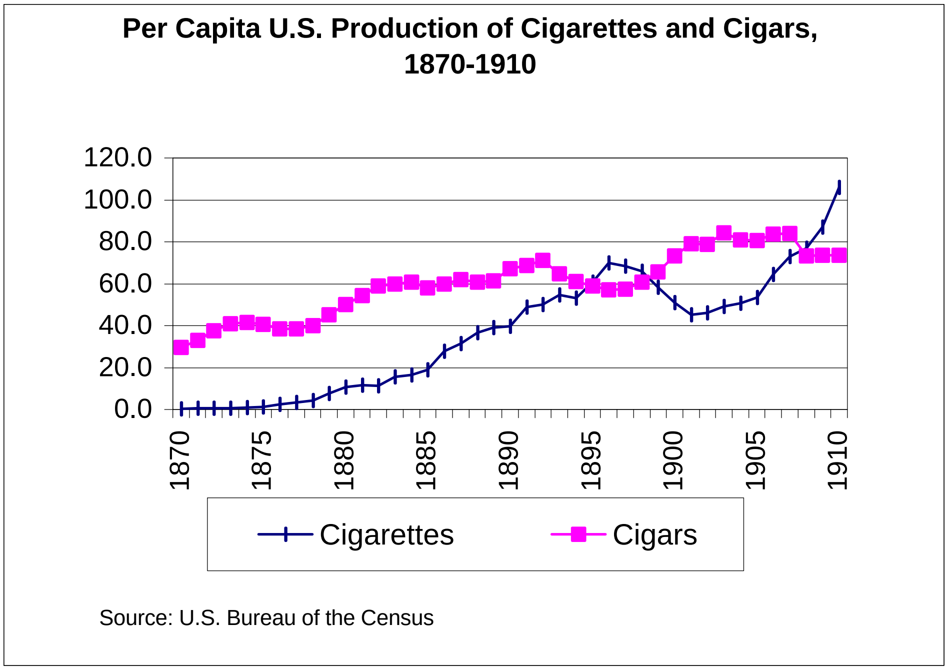
From 1870 to 1910, the U.S. experienced a dramatic continuation of the trend towards heavy industry and population concentration in large cities. Since a primary reason for living in the large cities was access to manufacturing jobs, industry and population growth tended to go hand in hand. Figure 1 below highlights growth in urbanization. From the end of the Civil War to 1910, the percentage of the population living in urban areas (over 2,500 residents) doubled. Even more striking is that most of this growth occurred in cities of over 50,000 residents.

Urbanization and industrialization both may have increased the odds of respiratory disease. Surely the filthy, crowded conditions of the large cities served to spread infectious agents, which may have contributed to the development of chronic respiratory problems. More likely still is that the air quality in cities may have been increasingly poor due to the lack of pollution control devices at manufacturing cites. Industrial toxins may have affected urban residents through the air they breathed both outside and on the factory floor. In modern times, a wide variety of industrial pollutants have been identified as contributors to occupational lung diseases. Although we don’t have direct air quality measures from this period, it is conceivable that air quality, at least in some areas, was significantly worse than it is today.



Respiratory disease may have been rising at the turn of the century for another reason—the dramatic upturn in smoking during the latter part of the nineteenth century. In modern epidemiological studies, the dominant risk factor for respiratory diseases such as emphysema and chronic bronchitis is cigarette smoking. In the mid nineteenth century, however, the cigarette in America was little more than a curio, though tobacco had long been consumed in other forms. But by the end of the century, the situation had changed. In 1839, the curing process for tobacco was revolutionized in North Carolina, giving birth to the "Bright Leaf" tobacco, which had the effect of making the smoke much easier to inhale than the dark leaf varieties found in cigar and pipe smoke. During the Civil War, tobacco use of all types spread among soldiers in America, just as it had earlier during the Crimean War in Europe And in 1884, Buck Duke, shortly to become the undisputed king of the tobacco industry, started to employ on a fulltime basis the revolutionary machinery patented by James Bonsack in 1880. The Bonsack machine allowed, for the first time, the mass production of cigarettes at a fraction of the cost it took to hire North Carolina girls and women to roll them by hand. [5]

The new technology, coupled with vigorous marketing campaigns by Duke and his competitors, introduced to the modernizing country a stylish, clean, cheap, and very efficient method of delivering tobacco smoke deep into the lungs, where it could pass directly into the bloodstream. While there are no data that I know of that reveal specific consumption patterns of tobacco (who smoked it, when, and how often), from U.S. government statistics, we can calculate per capita production of cigarettes going back to 1870. Figure 2 displays the ten-fold increase that occurred in per capita cigarette production between 1880 and the end of the century. [6]



[5] This paragraph constitutes a much condensed version of Kluger's (1996) fascinating history of the tobacco industry.
[6] Tobacco production numbers are my calculations from the published government statistics (U.S. Bureau of the Census, 1976). These numbers do not count for either exports or imports of cigarettes, nor changes in the composition of smokers, such as increases in the rate of smoking by women. Also, a large number of people still rolled their own cigarettes, but these numbers aren't included Figure 1.

While the upward trend in cigarette production is striking, two features of Table 2 need to be noted. First, the rise in production after 1910, not shown in the figure, is even more profound, with per capita production rising from about 100 per year in 1910 to 1,000 by 1930 and 2,500 by the end of World War II. Though part of this growth can be attributed to increased exports, it is clear that post-1910 consumption was dramatically higher than pre-1910 levels. Second, there is a notable downswing that occurs in cigarette production between 1895 and 1905 (though an upswing in cigar production compensates for this lull). This movement is likely due to the vigorous actions of social reformers who, convinced that cigarettes were either unhealthy, immoral or both, successfully stigmatized cigarette smoking and even succeeded in banning their sale in some states for a time (Kluger, 1997).

Other public health reforms pushed ahead during the latter part of the century may have had significant impacts on chronic disease incidence and prevalence. Garbage was being picked up, water supplies began to be protected and the general consciousness about the spread of disease increased. For instance, when Koch identified the bacteria responsible for tuberculosis in 1882, the annual death rate from tuberculosis was about 300 cases per 100,000 persons. By the time streptomycin (the first effective treatment) became available in the 1940s, the death rate had already fallen to below 50 cases, with about half the decline occurring before 1910. This decline illustrates dramatically the effectiveness of the public health movement.[7] (Leavitt and Numbers, 1986)

In summary, even though the years surrounding the turn of the century were characterized by important reforms in public health, it was still a time of rapid population

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[7] Other measures indicate the effectiveness of public health advances, such as the halving of the infant mortality rate between 1880 and 1910.

movements to the big city, both from the countryside and from abroad, and it was a heyday of manufacturing unhampered by modern pollution controls or workplace safety regulations. It was also a few years after the dawn of an extremely important new health risk—the mass-produced cigarette. Furthermore, the elderly people most at risk for chronic disease had a nutritional history which, as measured by their heights, declined across successive birth cohorts.[8] Thus, several factors were present which could have caused the prevalence of respiratory disease to be either rising or falling at the turn of the century.

3. Classification of Respiratory Disease

A. The Modern Conception

Respiratory diseases are a diverse group of disorders. They are characterized by various symptoms, attributed to numerous causative factors—most poorly understood—and diagnosed with a variety of tools. It is convenient for the purpose at hand to make a distinction between upper respiratory (UR) conditions, including diseases of the nasal passages, sinuses, larynx, and pharynx, and lower respiratory (LR) conditions, which include diseases of the bronchi and the lungs. An additional useful classification is provided by the 9th version of the *International Classification of Disease* (ICD-9), which differentiates between the following major groupings:

1) Acute respiratory infections (460-469)[9]

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[8] For example, the cohort aged 60-65 in 1890 had a better nutritional history, as measured by height, than cohorts entering the same age range in 1895, 1900, 1905 and 1910.

[9] In the ICD-9 classification system, the three digit codes (which are given here in parentheses) are usually further differentiated with fourth or even fifth digit classifications. For example, 493 refers to asthma,

2) Other diseases of the upper respiratory tract (470-478);

3) Pneumonia and influenza (480-487);

4) Chronic obstructive pulmonary disease and allied conditions (490-496);

5) Pneumoconiosis and other lung diseases due to external agents (500-508);

6) Other diseases of the respiratory system (510-519).

Although UR diseases are usually acute in nature and caused by bacterial or viral infection, chronic inflammation does occur. Indeed, the most commonly reported chronic condition in the National Health Interview Surveys is chronic sinusitis (sinus inflammation), with a prevalence of 13.6% among the general U.S. population in 1990-1992. Slightly less prominent is hay fever or allergic rhinitis, which has a prevalence of 9.7%.[10] In addition to chronic sinusitis (473) and allergic rhinitis (477), chronic UR conditions include deviated nasal septum (470), nasal polyps (471), as well as diseases of the nose and pharynx (472), tonsils and adenoids (474), and the larynx and trachea (476).

Upper respiratory conditions have a high degree of overlap. Oftentimes, for instance, inflammation of the nasal passages is associated with sinus inflammation. A common cause of UR inflammation is the presence of allergens. Seasonal, regional and climactic variation in allergens, as well as other organic and inorganic particles, is thought to influence the prevalence of chronic UR disease. In the late 20th century United States, the regional variation in common UR conditions is readily apparent, especially in the case of chronic sinusitis. While the self-reported prevalence of chronic sinusitis is 17.5% in the South and 15.7% in the Midwest, in the Northeast it is only 9.4%, and in the

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which is further differentiated as extrinsic asthma (493.0), intrinsic asthma (493.1), chronic obstructive asthma (493.2) and asthma, unspecified (493.9).

[10] Prevalence rates are from Collins (1997).

West it is merely 8.8% (just over half the rate in the South). It is the West, however, that faces the highest rate of allergic rhinitis (11.7%), followed by the South (10.2%), the Northeast (8.5%) and the Midwest (8.2%). The South, therefore, has a relatively high prevalence for both sinusitis and rhinitis, while the Northeast has relatively low rates for both conditions. The West, probably because of its relatively arid climate, is prone to rhinitis but not sinusitis, while the situation is reversed in the Midwest.[11] In a recent important study, Ponikau et al. (1999) argue that the dominant cause of chronic sinusitis is not an allergic reaction at all, but an immune system response to fungus. Further study may attribute may show the importance of region and climate as related to the presence of the fungus.

Table 1 below lists definitions of the most important chronic LR conditions. Goldring, James and Anderson (1998) note that clinicians use a great variety of terms to define specific combinations of symptoms. Among the LR conditions, the most prominent are those conditions usually associated with obstruction of the airways. These include chronic bronchitis, emphysema and asthma. The term *chronic obstructive pulmonary diseases* (COPD) is often used clinically as a non-specific catch-all term used to describe chronic respiratory disease. Following the above authors, I will define the term COPD to include either chronic bronchitis or emphysema. A common classification is represented in the schema given in Figure 3, which is adapted from Snider's characterization of the definitions put forward by the American Thoracic Society (Snider, 1998). Diseases not allied with pulmonary obstruction include a variety of occupational

[11] Prevalence rates cited here are from Collins (1997). Data come from self-reported conditions in the National Health Interview Surveys, 1990-1992. Rates are not adjusted for age or other factors.

lung diseases (pneumoconiosis), and other diseases such as empyema (510) and pleurisy (511).

Table 1: Definitions of Specific Chronic Lung Diseases

Disease Group	*ICD-9 Codes*	*Description*
Cystic Fibrosis	277.00, 277,01	Genetic disease with exocrine gland dysfunction resulting in pancreatic insufficiency, chronic progressive lung disease, and elevated sweat chloride concentration
Chronic Bronchitis	490-491	Excessive tracheobronchial mucus production associated with narrowing of the bronchial airways and cough
Chronic Obstructive Bronchitis	491.2	Same as chronic bronchitis with involvement of smaller airways associated with airflow abnormalties
Emphysema	492	Alveolar destruction and associated airspace enlargement
Asthma	493	Reversible ariway obstruction with airway inflammation and increased airways responsiveness to a vareity of stimul
Bronchiectasis	494	Destruction of bronchial wall
Allergic alveolitis	495	Immunologically induced inflammation of the lung parenchyma
Chronic airway obstruction	496	Generalized airway obstruction not classifiable as chronic bronchitis or chronic obstructive bronchitis
Other externally induced pneumoconioses	500-504, 506.4, 507.1, 507.8, 515, 516.3	Dust-, fume-, or mist-induced pneumoconioses or lung injury, nonimmunologically mediated
Sleep apnea	780.51, 780.53, 780.57	Repetitive cessation of breathing during sleep.

Source: Goldring, James and Anderson (1998).

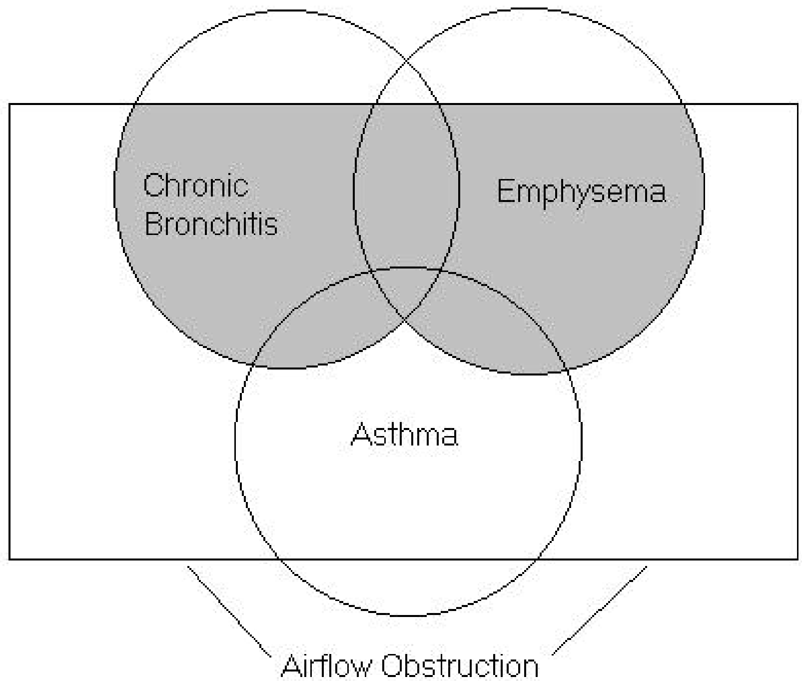

Figure 3. Chronic Lung Diseases (COPD in shaded area)

Source: Adapted from Snider (1998).

The causes of lung disease are varied and not fully understood. COPD is generally believed to result from exposure of lung tissue to environmental agents, primarily tobacco smoke. According to the Surgeon General, almost 90% of COPD is attributable to cigarette smoking (U.S. Dept. of Health and Human Services, 1994).[12] Asthma is typically classified as either allergic (extrinsic) or nonallergic (intrinsic). Allergic asthma is dominant in children, while adults have both allergic and nonallergic asthma in about equal numbers (White and Kaliner, 1991). Given that a family history of asthma is a significant risk factor, asthma may be, in part, genetically determined. In

[12] A small number of persons with COPD have a genetically determined deficiency of the protein alpha1-antitrypsin, a trait present in approximately 7% of the population (Snider, 1998).

children, chronic exposure to allergens (primarily indoors) is associated with increased risk of asthma. The identified risk factors associated with adult onset of asthma are largely unknown, though occupational dust is a known cause (a condition usually classified as occupational asthma). Other occupational lung diseases, such as siliocis, asbestosis and coal-workers pneumoconiosis, are also the result of numerous environmental agents. Finally, interstitial lung diseases[13] have largely unidentified risk factors, though smoking and environmental agents are suspected causes.[14]

B. The historical record

A central concern in using the Union Army data, which cannot be fully resolved within the scope of this project, is whether or not the diagnoses of examining physicians in the late 19th and early 20th centuries were valid and reliable. Physicians could visually observe UR conditions, but LR conditions would have been more challenging, though simple physical exam techniques can reveal much about the general conditions of the lung. Certainly the 19th century physicians lacked a variety of modern diagnostic techniques, such as spirometry (which measures the expired volume as function of time), various tests for lung capacity, x-ray, biopsy of lung tissue, arterial blood gas measurements and CT scanning of the chest (Snider, 1998). However, patient-reported symptoms and history, which were available historically, still play a dominant role in diagnosing respiratory diseases today.

Although legitimate concerns remain about diagnostic competency and, in particular, the physicians' ability to differentiate between specific diagnoses, the

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[13] Interstitial disease is that which occurs in the spaces between different tissues in the lung. These diseases are described generally as pulmonary fibrosis, alveolitis and pneumonitis.

[14] The preceding paragraph summarizes, again, the discussion of Goldring, James and Anderson (1998).

historical classification of disease was not far removed from what exists today. In 1892, William Osler (1892) published what was quickly to become the most important medical text of the day. He classified both chronic and acute diseases of the UR system, including the nose, larynx, and pharynx. He also gave detailed discussions of diseases of the bronchi and lungs. Chronic bronchitis is characterized by a general inflammation of the bronchi characterized by chronic shortness of breath. Osler differentiates asthma from chronic bronchitis by the tendency of asthmatics to have severe attacks: "One of its most striking peculiarities is the bizarre and extraordinary variety of circumstances which at times induce a paroxysm." Although emphysema could not have been confidently diagnosed prior to autopsy, Osler notes that the condition led to "enlargement of the lungs, due to distension of the cells and atrophy of their walls, and clinically by imperfect aeration of the blood and more or less marked dyspnoea."

The classification system used by Osler is remarkably similar in many respects to what we use today. Though autopsy allowed a greater understanding of conditions than physicians would have been able to diagnose with living patients, the physicians of the day reported a wide variety of both upper and respiratory conditions that correlate closely with modern categories of respiratory diseases. The analysis that follows takes these physicians at their word. Since much more research is necessary to make confident comparisons between historical rates of respiratory disease, I will make such comparisons only in passing. The central intent here is to explore the variation in these physican-diagnosed conditions across important variables and across the period of study.

4. Methods

A. The Pension System and Surgeons' Certificates

The Civil War pension system began in 1862 as a means of providing financial support for soldiers disabled in battle. From this early date throughout the life of the system, applicants for assistance appeared before a board of examining physicians who conducted a detailed physical exam and forwarded their findings, noted on what was typically called a "surgeons' certificate" to the pension board. These medical exams provide the essential data used in this study. Of the 35,570 Union Army veterans in the sample, 17,721 were examined at least once during their lives. A total of 87,271 examination records exist on these veterans, with an average of 4.9 exams (median=4) per veteran.

Changes in the pension laws fundamentally affected the number of medical exams that are available for analysis. For several years, the pension system was available only to people who could prove that their disability was somehow related to service in the military. This greatly limited the number of pensioners, though, in practice, a wide variety of conditions, such as "rheumatism" or heart disease, were commonly ascribed to military service. In 1890, however, the system was changed dramatically and any disabled veteran was eligible for coverage as long as he had served a period of at least 90 days in the war. In 1904, Teddy Roosevelt issued an executive order that further expanded coverage, classifying "old age" as an infirmity, and Congress changed the law in 1907 making the pension system officially age-based. However, under the 1890 law, veterans who were aged 65 or older received a minimum pension unless they were "unusually vigorous." Thus any veteran over age 62 became eligible for a pension.[15]

[15] See the discussion of the pension laws in Fogel (1999).

These legal changes significantly affected the number of veterans getting a physical exam in any given year. Furthermore, as the veterans aged, they naturally acquired new conditions that made them eligible for new and increased support, which would often lead to a new examination. Figure 4 below illustrates the annual rate of examination. The figure graphs the number of recruits examined in each year as a percentage of all veterans who would at some point be in the system and who were known to be alive during the year indicated. The figure reveals the dramatic influx of exams following the implementation of the 1890 law. In 1891, half the veterans in the sample were examined.

Although the role of the physician was to provide a basis for granting or rejecting the claimant's petition, eligibility for the pension was not determined by the physician, but by the pension board. The physicians' duty was to investigate the conditions made in the claimant's statement and to provide a systematic physical exam that was spelled out in a set of standardized instructions. The physicians would typically go through the body systems one by one (usually starting with the cardiovascular system, followed by the respiratory system) and note any findings, whether positive or negative. Thus many conditions could be recorded whether or not they were reported by the claimant and whether or not they were pensionable.

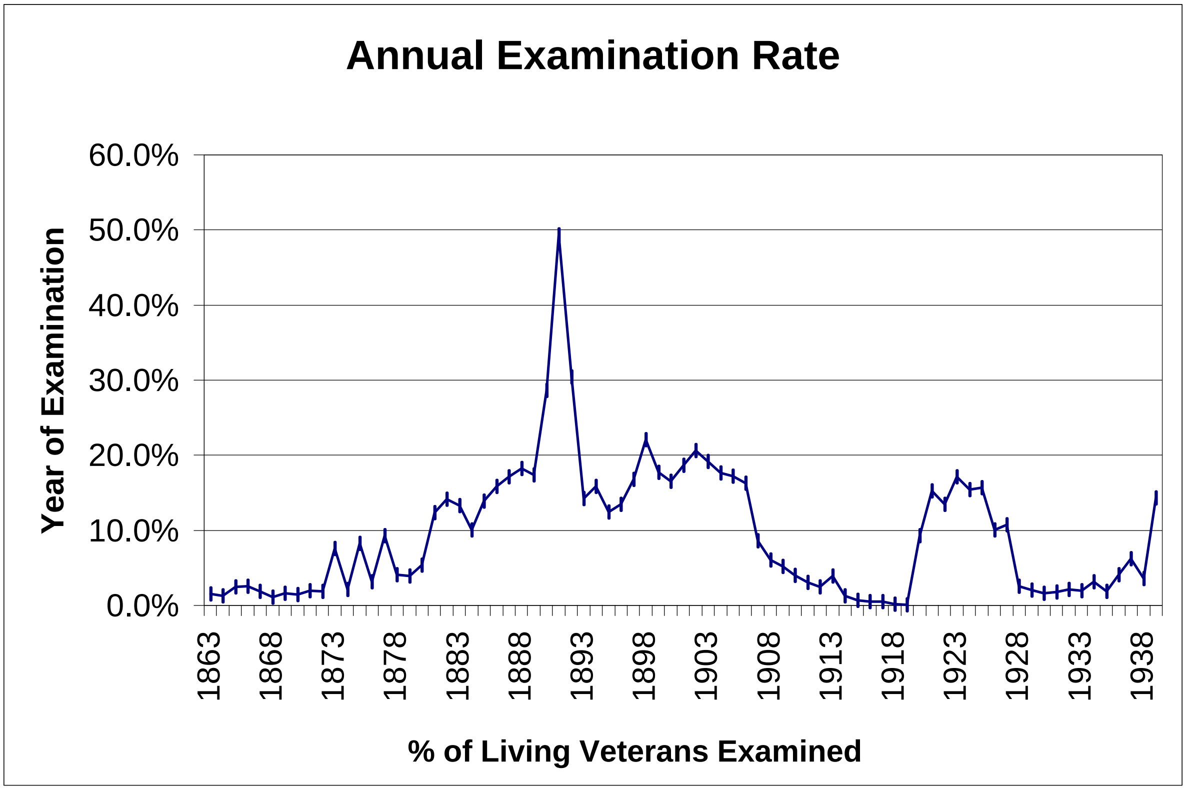

Figure 4. Annual Examination Rate among Current and Future Civil War Pensioners

B. Disease Categories

The respiratory findings the physicians report are extensive and the classification scheme used at the time was remarkably similar to the one we have today. The collection of this data into electronic form was designed to organize the data as much as possible without losing any of the detail present in the exams, thereby precluding future researchers from developing their own classification system. Consequently, in the data inputting process, exam findings are entered chiefly in open-ended form. To facilitate the inputting process, the data collection team developed specially designed computer "screens," which correspond to each major body system.

This research exploits three central variables on the respiratory screen. First, a field exists for the description of any UR inflammation. Data is entered into this field essentially as it is written on the examination certificate. In all, there are over 18,000 unique phrases in the data that indicate the presence (or lack) of an UR inflammation, such as rhinitis, tonsilitis or pharyngitis. Oftentimes there are several UR comments on a given exam. Since the overwhelming majority of these inflammations are likely due to acute infections, UR inflammations are considered here only if the certificate explicitly states the condition is "chronic."

Second, specific LR conditions are also noted, though sometimes in very unspecific terms, such as "disease of the lung." There are, however, relatively frequent observations of the three main types of chronic lung diseases outlined above: emphysema, chronic bronchitis and asthma. Tuberculosis is also present, but, since tuberculosis is usually not classified with other respiratory conditions, it is not included here. Observations that are chronic in nature but where no mention of the above specific conditions are made are included in the "other" category. Other LR observations are considered acute unless they are specifically designated chronic by the physician.[16]

Third, as part of the examination process, physicians would often designate particular conditions as deserving of compensation. These physician "ratings" are an indicator of chronicity, since only chronic conditions were eligible for pension assistance. Oftentimes, the rating is the only piece of information present on a particular body

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[16] Findings assumed to be chronic include adhesion, allergy, anthracosis, atrophy, bronchiectasis, cavity, empyema, fibrosis, pleuritis and pneumonitis. The findings assumed to be acute, unless specifically indicated to be chronic, are abscess, atelectasis, bronchitis, edema, effusion, hemoptysis, pneumonia, pneumothorax, tracheitis and diseases of the lungs not further specified. The conditions mentioned here are actually standardizations of a wide variety of synonyms. The scheme for standardizing these synonyms was developed by Dr. Louis Nguyen, in consultation with the other physicians involved in the collection of the Surgeons' Certificates. Dr. Nguyen also recommended which findings to classify as chronic. I performed the actual coding of the data and all mistakes are, consequently, my responsibility.

system. Even though the ratings sometimes lack specificity, they provide a valuable source of summary information on whether the physician viewed the claimant as having respiratory disease severe enough to warrant disability compensation.[17]

Other information related to the respiratory screen—such as dyspnea, respiratory sounds, cough descriptions and indications of pulmonary dullness—may prove useful in making further diagnoses I have confined this analysis, however, to specific diagnoses made by the examining physicians. Future research may be served by exploitation of these additional variables. Given the variable descriptions and caveats noted above, I present in the next section prevalence rates for chronic respiratory disease in six categories:

1. Chronic disease of the UR system
2. Chronic disease of the LR system
3. Chronic disease in either the UR or LR system
4. Any diagnosed or rated (DOR) respiratory disease
5. Asthma
6. COPD

These categories, therefore, represent both system-level classification of chronic illness as well as two important specific chronic diseases, asthma and COPD. The DOR category is the most general and indicates the presence of either a specifically designated chronic LR or UR condition or a physician rating. Due to the non-specific nature of many of the exams, the DOR category is useful for measuring the prevalence of respiratory disease in general.

[17] Determining whether a rating was given is actually a rather involved process that requires sifting through the respiratory rating variables (p_rat*) as well as at the related diseases variables (p_rel*), which often contains indications that lung diseases is “rated with” another non-respiratory condition.

C. Prevalence Estimation

Strictly speaking, the estimates provided are not point prevalence rates for each disease category. Because of the irregular and sometimes infrequent examinations, the outcome to be measured is "percentage ever diagnosed." Given the chronicity of the conditions under study and the lack of effective treatment, this measure is a suitable proxy for the actual prevalence and has been used in other studies with this same data (Costa, 2000).

In order to minimize the under-enumeration of conditions in those cases where a recent examination hasn't been conducted, only those individuals who have been examined in the previous five years prior to the prevalence date are included, though this approach will still underestimate the prevalence, since a portion of the population will have acquired respiratory conditions since their most recent exam. A potential bias in the other direction is that it may be that those applying for additional assistance are, in general, less healthy than those who don't get examined.

An examination of Figure 3 reveals an obvious time period for examining the prevalence of disease in general, namely the period following the rapid influx of veterans into the system after the liberalization of the law in 1890. For the next several years, a relatively high annual rate of examination exists which remains well over 15% through 1906. In 1907 the rate falls precipitously and examinations virtually disappear over the next decade.[18] Given the time pattern of examinations reflected in Figure 4, I calculate prevalence at four dates: January 1 of 1895, 1900, 1905 and 1910. In each case, only

[18] On February 6, 1907 Congress passed the Service and Age Pension Act which introduced a new age-based system, though it is not clear if this was the reason why physical exams disappeared. In 1917, 1918 and 1920 further amendments were made to the laws. (Sanders 2000) The administrative policies which may have been associated with these acts, including a reappearance of regular exams following 1920 (even though by this time, all Civil War veterans qualified for age-based assistance) have not been investigated.

those cases known to be alive[19] on that date and examined in the previous five years are included in the denominator. The decline in the examination rate from in 1907-1909 will likely cause prevalence in 1910 to be underestimated relative to the other years.

Finally, prevalence calculations are broken down according to age, occupation, and population. Five-year age cohorts are created and tracked over the entire 15-year period. Because these are veterans of the Civil War, the age distribution of the sample is not representative of the age distribution in the general population.[20] Occupations are classified using the coding scheme used in all the publicly-released data collections of the Union Army veterans and consists of farmers, professionals and proprietors, artisans, laborers, retired, and unknown. The city of residence is typically known at the time of exam. Each city is classified according to its population in 1900; thus, the relative growth in different cities is not captured in the analysis. For those living in cities under 25,000, the cases are separated into farmers and non-farmers. Other variables present in the AVUA data collections that may be incorporated into future analyses will be discussed later.

5. Results

This section presents an array of results concerning the distribution of respiratory disease in the population over the 15-year period under study. In order to simplify the presentation, confidence intervals are not reported for the descriptive statistics. As a general rule, the differences between years are statistically significant, while the

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[19] This is either from a death date recorded in the pension files (the majority of cases) or from the existence of a subsequent exam.

[20] Also, among those who were 45-49 in 1895, most were in the 48-49 age group, since few people in the 45-47 group were young enough to have served in the military.

differences across categories are not. Significance levels are reported for the probit regression results that follow the discussion of the descriptive statistics.

A. Age and Date

Table 2 below presents age breakdowns for each of the (non-exclusive) disease categories noted above. Sample sizes for each cell are given in the lower right corner of the table. Note that changes from 1895-1910 in the age-specific rates can be observed by following the same age group horizontally across the columns. Within-cohort changes over time are seen by tracking the cohort diagonally (in a southeasterly direction). The prevalence of disease among the oldest age groups, however, should be interpreted cautiously, given the small sample sizes in those cohorts.

Not surprisingly, the within-cohort prevalence increases for almost all cohorts and almost all categories.[21] More remarkable, however, is that age-specific disease rates are rising significantly over time for all categories. The biggest jump is generally between 1895 and 1900, but increases continue through 1910. Across the broad categories of LR and UR disease, the prevalence rates double or triple in the period across age groups. For specific conditions, asthma also rises significantly between 1900 and 1910 (except for the 75-79 and 80-84 groups), while COPD increases are generally more modest, except for the sharp jump among the 75-79 year olds.

Table 2 also reveals important differences between the experiences of successive cohorts. If we look at the summary measure of all chronic respiratory conditions (which include physician ratings of disease that is not specifically identified as occurring in

[21] The cohort that is age 70-74 in 1900 experiences a modest decline in prevalence between 1900 and 1905 for both lower and UR conditions, as well as for asthma. The prevalence increases, however, for the category of COPD and the broad category of physician-rated respiratory disease.

Table 2: Physican-Diagnosed Chronic Respiratory Conditions--By Age
Percent of Living Pensioners Ever Diagnosed

Lower Respiratory

Age	1895	1900	1905	1910
45-49	5.7%			
50-54	6.4%	8.1%		
55-59	6.0%	9.0%	9.5%	
60-64	6.0%	9.3%	10.7%	11.3%
65-69	5.4%	7.9%	10.6%	12.2%
70-74	5.4%	8.8%	11.6%	14.3%
75-79		7.1%	7.7%	18.1%
80-84			10.9%	4.2%

Diagnosed or Rated

Age	1895	1900	1905	1910
45-49	30.5%			
50-54	30.4%	40.7%		
55-59	26.7%	41.2%	44.7%	
60-64	25.1%	37.8%	45.1%	47.4%
65-69	24.9%	34.9%	42.7%	46.2%
70-74	21.4%	37.6%	41.5%	46.7%
75-79		34.0%	40.1%	49.2%
80-84			34.4%	45.1%

Upper Respiratory

Age	1895	1900	1905	1910
45-49	8.0%			
50-54	7.6%	13.9%		
55-59	6.4%	12.6%	16.3%	
60-64	6.1%	10.3%	14.1%	20.3%
65-69	7.2%	9.2%	13.8%	14.1%
70-74	6.5%	11.1%	12.1%	14.6%
75-79		7.1%	10.9%	13.0%
80-84			9.4%	15.5%

Asthma

Age	1895	1900	1905	1910
45-49	2.4%			
50-54	2.4%	3.9%		
55-59	2.3%	3.6%	4.2%	
60-64	2.3%	3.8%	4.2%	5.0%
65-69	2.7%	2.5%	4.5%	4.7%
70-74	3.6%	4.1%	4.9%	6.6%
75-79		2.8%	3.2%	2.8%
80-84			6.3%	0.0%

Upper or Lower

Age	1895	1900	1905	1910
45-49	12.6%			
50-54	12.9%	20.0%		
55-59	11.7%	19.4%	23.6%	
60-64	11.4%	17.8%	22.3%	27.9%
65-69	12.0%	15.7%	21.6%	23.1%
70-74	10.9%	18.6%	21.6%	25.1%
75-79		13.5%	17.3%	28.8%
80-84			17.2%	18.3%

COPD

Age	1895	1900	1905	1910
45-49	1.4%			
50-54	1.7%	2.4%		
55-59	1.8%	2.6%	2.0%	
60-64	1.8%	3.4%	3.0%	2.3%
65-69	1.7%	3.3%	3.6%	4.2%
70-74	1.7%	2.9%	3.6%	4.1%
75-79		2.8%	4.0%	8.5%
80-84			2.5%	1.4%

Sample Size

Age	1895	1900	1905	1910
45-49	1,821			
50-54	4,239	1,166		
55-59	2,625	2,531	990	
60-64	1,761	1,497	2,228	666
65-69	1,031	958	1,298	1,319
70-74	477	441	708	610
75-79		141	284	177
80-84			64	71

Notes: Percentages are calculated only for those cases where the veteran was examined in the five years prior to the date indicated. See text for definitions of disease categories. All years represent the percentage as of January 1.

either the upper or LR system), we see that in 1895, the younger cohorts start out with significantly higher prevalence than older cohorts. This cross-section distribution may be due to two factors, both of which merit considerable further research. First, the overall force of mortality was high, which may have led to a declining prevalence across age groups at a point in time. Second, recent research referred to earlier on the antebellum patterns in adult heights suggests that these younger cohorts were shorter than the older groups indicating a harsher nutritional and disease history. Thus the later occurrence of disease may be linked to the early nutritional experience of the recruits.

Even though the younger groups have higher rates of disease in 1895, it is the older groups who see the sharpest increase in disease rates over the next 15-year period, and by 1910 the age profile has flattened considerably. It is particularly notable that over this time period there is a sharp divergence between UR and LR conditions with respect to the age pattern. Whereas an inverse relationship between age and prevalence exists for UR conditions in 1910, there is a positive association between age and the prevalence of LR conditions. Further analysis may attribute this trend to other influences, but it may be the case that older cohorts are starting to see the effects of increased long-term exposure to environmental agents such as cigarette smoke and industrial pollutants.[22]

B. Region, Population and Occupation

As noted earlier, the prevalence of UR conditions varies significantly by region in the modern United States. Regional variation for UR conditions is also apparent among the Union Army veterans. In 1910, the rate of UR disease is about 10% in the New

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[22] The glaring exception to the trend in LR disease is the sharp decline in prevalence for the oldest group shown in Table 2, though the small sample size at these old ages makes it hard to interpret this outcome.

England and Mid-Atlantic regions, 16-18% in the North Central regions, 18.3% in the South and Border States and 20.3% in the West. Interestingly, these differences are much less pronounced in earlier years of the period, though the pattern exists in 1895 for respiratory conditions in general. Also notable is that LR conditions follow the same pattern (though the range is much smaller), with the striking exception of a dramatically low rate of LR disease in the South and Border States. No obvious explanation exists for this anomaly.

Given the rapid shift of the 19th century population to the nation's large cities, which are widely viewed as teeming with filth and disease, we might expect that the large cities would be characterized by high rates of respiratory illness. While cities may have experienced higher *incidence* of disease, Table 3 reveals that the *prevalence* of chronic respiratory conditions was actually lower in the cities than in locales with fewer than 25,000 people. This was particularly the case for UR conditions, with only 7.7% of those living in cities with population over 500,000 ever having been diagnosed with an UR condition. LR conditions, however, are relatively prevalent in large cities, though the differences are relatively small, especially for the specific conditions of asthma and COPD.

The impact of urbanization is also evident in comparing the interaction between city size and occupation. In the 19th century, farmers were clearly the healthiest occupational group, but it is not clear whether the farming advantage was due to factors associated with living on a farm (such as better nutrition) or because of lower population density. Tables 4 and 5 yield mixed results. Among veterans living in communities smaller than 25,000, those who were farmers had significantly lower rate of respiratory

Table 3: Physican-Diagnosed Chronic Respiratory Conditions--By Region
Percent of Living Pensioners Ever Diagnosed

Lower Respiratory

Region	1895	1900	1905	1910
New England	5.3%	6.7%	7.2%	10.2%
Mid-Atlantic	4.8%	7.5%	10.2%	10.7%
E. North Central	6.4%	9.3%	11.0%	13.7%
W. North Central	7.1%	9.9%	10.0%	13.2%
South/Border St.	3.9%	6.8%	9.4%	5.4%
West	6.7%	9.6%	10.6%	15.8%

Diagnosed or Rated

Region	1895	1900	1905	1910
New England	20.1%	25.1%	31.5%	38.2%
Mid-Atlantic	23.2%	35.0%	38.3%	40.3%
E. North Central	31.4%	42.5%	47.2%	49.5%
W. North Central	29.0%	39.8%	45.2%	50.4%
South/Border St.	31.3%	43.6%	49.9%	45.2%
West	23.0%	36.7%	37.6%	43.0%

Upper Respiratory

Region	1895	1900	1905	1910
New England	6.0%	7.9%	9.3%	10.2%
Mid-Atlantic	6.1%	9.1%	10.9%	10.3%
E. North Central	7.5%	12.8%	15.5%	16.5%
W. North Central	7.7%	12.9%	14.9%	18.1%
South/Border St.	8.2%	13.1%	16.6%	18.3%
West	5.6%	11.3%	13.3%	20.3%

Asthma

Region	1895	1900	1905	1910
New England	2.1%	3.0%	3.3%	4.5%
Mid-Atlantic	2.2%	3.6%	5.3%	5.6%
E. North Central	2.7%	3.7%	4.5%	5.0%
W. North Central	2.4%	3.5%	3.7%	4.8%
South/Border St.	1.5%	3.0%	3.0%	2.2%
West	2.5%	3.2%	3.3%	3.8%

Upper or Lower

Region	1895	1900	1905	1910
New England	10.7%	13.3%	15.6%	19.1%
Mid-Atlantic	10.5%	15.3%	19.1%	19.3%
E. North Central	12.8%	19.9%	23.7%	26.2%
W. North Central	13.6%	20.6%	22.4%	27.9%
South/Border St.	11.9%	18.2%	24.1%	22.0%
West	10.7%	18.7%	21.5%	29.7%

COPD

Region	1895	1900	1905	1910
New England	1.2%	2.7%	2.4%	3.2%
Mid-Atlantic	1.1%	2.6%	2.5%	2.4%
E. North Central	2.2%	3.5%	3.6%	5.1%
W. North Central	1.7%	2.6%	2.5%	3.2%
South/Border St.	1.1%	1.9%	2.8%	1.1%
West	1.8%	1.3%	2.1%	5.1%

Sample Size

Region	1895	1900	1905	1910
New England	768	406	333	157
Mid-Atlantic	2,493	1,403	1,141	534
E. North Central	4,548	2,638	2,194	1,235
W. North Central	2,593	1,377	1,085	524
South/Border St.	852	473	361	186
West	447	311	330	158

Notes: Percentages are calculated only for those cases where the veteran was examined in the five years prior to the date indicated. See text for definitions of disease categories. All years represent the percentage as of January 1.

Table 4: Physican-Diagnosed Chronic Respiratory Conditions--By Population
Percent of Living Pensioners Ever Diagnosed

Lower Respiratory

City Population (1900)	1895	1900	1905	1910
500,000+	6.5%	9.8%	11.6%	13.6%
100-499,000	5.4%	7.8%	8.4%	10.6%
25-99,000	5.0%	7.3%	9.1%	7.1%
0-24,000 (Non-Farmer)	6.1%	8.1%	9.7%	11.8%
0-24,000 (Farmer)	14.0%	7.4%	10.9%	18.0%

Diagnosed or Rated

City Population (1900)	1895	1900	1905	1910
500,000+	14.3%	28.2%	28.3%	29.7%
100-499,000	30.3%	41.3%	46.3%	45.2%
25-99,000	23.2%	33.4%	34.2%	39.6%
0-24,000 (Non-Farmer)	28.1%	38.9%	43.8%	48.4%
0-24,000 (Farmer)	30.4%	41.2%	46.2%	47.9%

Upper Respiratory

City Population (1900)	1895	1900	1905	1910
500,000+	2.2%	5.2%	9.1%	7.7%
100-499,000	7.3%	12.0%	14.4%	15.1%
25-99,000	6.0%	9.3%	12.3%	17.1%
0-24,000 (Non-Farmer)	7.3%	11.6%	14.2%	15.7%
0-24,000 (Farmer)	7.5%	12.7%	14.3%	16.1%

Asthma

City Population (1900)	1895	1900	1905	1910
500,000+	1.5%	3.2%	4.5%	4.4%
100-499,000	2.9%	4.3%	5.6%	6.8%
25-99,000	1.8%	2.7%	3.4%	2.1%
0-24,000 (Non-Farmer)	2.5%	3.3%	4.0%	5.0%
0-24,000 (Farmer)	2.4%	3.9%	4.8%	5.2%

Upper or Lower

City Population (1900)	1895	1900	1905	1910
500,000+	6.1%	11.3%	15.7%	16.5%
100-499,000	12.2%	18.0%	20.4%	22.6%
25-99,000	10.4%	14.5%	16.8%	19.8%
0-24,000 (Non-Farmer)	12.4%	18.1%	22.3%	25.5%
0-24,000 (Farmer)	12.9%	20.3%	23.3%	26.2%

COPD

City Population (1900)	1895	1900	1905	1910
500,000+	1.5%	3.2%	2.5%	2.2%
100-499,000	1.4%	3.0%	1.1%	2.1%
25-99,000	1.5%	2.7%	0.9%	2.1%
0-24,000 (Non-Farmer)	1.7%	2.8%	3.5%	4.1%
0-24,000 (Farmer)	1.7%	3.0%	3.2%	4.4%

Sample Size

City Population (1900)	1895	1900	1905	1910
500,000+	413	248	198	91
100-499,000	558	300	270	146
25-99,000	715	407	351	187
0-24,000 (Non-Farmer)	6,307	3,260	2,514	1,291
0-24,000 (Farmer)	3,768	2,485	2,209	1,132

Notes: Percentages are calculated only for those cases where the veteran was examined in the five years prior to the date indicated. See text for definitions of disease categories. All years represent the percentage as of January 1. The "Non-Farmer" designation includes the substantial number of cases where occupational category is unknown. It also includes farmers who have retired. Cities are categorized based on their population in 1900.

Table 5: Physican-Diagnosed Chronic Respiratory Conditions--By Occupation
Percent of Living Pensioners Ever Diagnosed

Lower Respiratory

Occupation	1895	1900	1905	1910
Farmer	6.5%	9.8%	11.6%	13.6%
Professional	5.4%	7.8%	8.4%	10.6%
Artisan	5.0%	7.3%	9.1%	7.1%
Laborer	6.1%	8.1%	9.7%	11.8%
Retired	14.0%	7.4%	10.9%	18.0%

Physican-Rated

Occupation	1895	1900	1905	1910
Farmer	30.2%	41.1%	45.9%	47.7%
Professional	29.3%	37.9%	41.3%	42.2%
Artisan	25.2%	37.3%	41.5%	43.5%
Laborer	26.1%	37.1%	41.2%	45.0%
Retired	45.2%	43.4%	42.9%	52.4%

Upper Respiratory

Occupation	1895	1900	1905	1910
Farmer	7.4%	11.3%	14.2%	16.2%
Professional	8.5%	12.6%	14.1%	15.2%
Artisan	7.0%	13.1%	14.2%	13.1%
Laborer	5.6%	12.1%	12.6%	13.2%
Retired	14.0%	8.7%	13.5%	19.4%

Asthma

Occupation	1895	1900	1905	1910
Farmer	2.4%	3.9%	4.6%	5.1%
Professional	2.2%	3.3%	3.3%	4.0%
Artisan	2.0%	2.9%	4.0%	2.4%
Laborer	2.5%	3.7%	4.3%	5.4%
Retired	8.6%	4.1%	4.8%	7.6%

Upper or Lower

Occupation	1895	1900	1905	1910
Farmer	12.9%	20.2%	23.1%	26.2%
Professional	13.0%	19.2%	19.6%	22.8%
Artisan	11.1%	17.4%	21.4%	18.6%
Laborer	11.1%	15.5%	20.9%	22.7%
Retired	24.7%	15.6%	22.0%	32.4%

COPD

Occupation	1895	1900	1905	1910
Farmer	1.7%	3.0%	3.1%	4.3%
Professional	1.4%	2.7%	2.6%	2.7%
Artisan	1.5%	2.7%	2.8%	2.7%
Laborer	1.8%	2.6%	3.0%	4.3%
Retired	3.2%	2.5%	3.5%	3.9%

Sample Size

Occupation	1895	1900	1905	1910
Farmer	3,883	2,542	2,281	1,165
Professional	1,388	850	690	329
Artisan	1,530	1,037	883	451
Laborer	1,994	1,337	1,059	516
Retired	93	122	459	355

Notes: Percentages are calculated only for those cases where the veteran was examined in the five years prior to the date indicated. See text for definitions of disease categories. All years represent the percentage as of January 1. The occupation unknown category is not included disease than their non-farming counterparts but were virtually identical in terms of UR conditions. This suggests that farmers faired better in avoiding the environmental agents that cause LR disease. But Table 5 reveals no such advantage for farmers. However, as is the case with population, the higher prevalence among farmers is likely to due to lower mortality, as will be illustrated shortly.

The descriptive statistics in Table 5 reveal few other notable differences across occupational categories. Many of the occupational lung diseases that have been identified in modern times cannot be adequately analyzed here without making more refined classifications. It makes sense that artisans have a lower rate of respiratory disease than laborers, but they also have an advantage over professionals and proprietors, which has no obvious explanation. The retired class has, in general, a higher rate of respiratory disease, but it must be noted that this group is older on average and, since disease and disability lead to retirement, they are likely to have higher morbidity rates across a variety of conditions.

C. Probit Regression Results

This section further explores demographic patterns in chronic respiratory disease by simultaneously controlling for the variables outlined above in a regression context. Probit equations will be estimated, one for each of the four prevalence dates under examination: 1895, 1900, 1905 and 1910. It should be emphasized that this analysis is exploratory and not designed to confirm the causality of any factors involved. The occurrence of disease is a function of a variety of processes over the life-cycle, while the regression equations account only for the variation in contemporaneous variables at a

Table 6: Marginal Effects for Probits

Dep. Variable:	*Any Lower Respiratory Condition*				*Any Upper Respiratory Condition*				*Any Diagnosed or Rated Condition*			
	1895	1900	1905	1910	1895	1900	1905	1910	1895	1900	1905	1910
Age: 45-49	-0.003				0.016 **				0.035 **			
Age: 50-54	0.004	-0.012			0.012 *	0.036 ***			0.034 ***	0.025		
Age: 55-59		-0.002	-0.009			0.022 **	0.024			0.032 **	0.021	
Age: 60-64	-0.001		0.002	-0.021	-0.003		0.003	0.062 ***	-0.017		0.025	0.017
Age: 65-69	-0.005	-0.014		-0.015	0.009	-0.013		-0.002	-0.020	-0.032		-0.003
Age: 70-74	-0.005	-0.006	0.009		0.002	0.005	-0.019		-0.053 **	-0.008	-0.015	
Age: 75-79		-0.021	-0.033 *	0.026		-0.037	-0.034	-0.024		-0.046	-0.039	0.004
Age: 80-84			0.001	-0.097 ***			-0.050	-0.007			-0.101	-0.047
Age: 85-89				0.013				-0.012				-0.141
<u>Population</u>												
500,000+	-0.013	-0.011	-0.021	0.003	-0.050 ***	-0.062 ***	-0.047 *	-0.074 *	-0.127 ***	-0.102 ***	-0.153 ***	-0.173 ***
100-499,000	-0.009	-0.003	-0.020	-0.023	-0.003	-0.005	-0.005	-0.016	0.014	0.010	0.016	-0.025
25-100,000	-0.009	-0.016	-0.030 *	-0.056 **	-0.013	-0.025	-0.019	0.021	-0.045 **	-0.054 **	-0.093 ***	-0.069 *
0-24,000			omitted				omitted				omitted	
Unknown	-0.014	-0.023	-0.070	-	-0.016	-0.030	-0.032	-	-0.111 ***	-0.145 *	-0.189 **	-
<u>Region</u>												
New England	0.007	-0.010	-0.030	0.005	-0.005	-0.019	-0.022	-0.006	-0.042 **	-0.109 ***	-0.078 **	-0.027
Mid-Atlantic			omitted				omitted				omitted	
E. North Central	0.016 **	0.015	0.004	0.025	0.008	0.030 ***	0.044 ***	0.062 ***	0.068 ***	0.063 ***	0.074 ***	0.079 ***
W. North Central	0.023 ***	0.019 *	-0.010	0.014	0.010	0.029 **	0.038 **	0.083 ***	0.042 ***	0.033 *	0.049 **	0.086 ***
South/Border St.	-0.012	-0.012	-0.014	-0.062 *	0.018 *	0.035 *	0.059 **	0.096 ***	0.074 ***	0.074 ***	0.101 ***	0.055
West	0.022	0.021	0.003	0.062 *	-0.010	0.013	0.019	0.102 ***	-0.017	0.004	-0.026	0.016
Unknown	0.047 **	0.003	0.073 **	0.135 **	-0.013	-0.028	0.013	0.071	0.063 *	0.056	0.102 **	0.130 *
<u>Occupation</u>												
Farmer			omitted				omitted				omitted	
Professional	-0.008	-0.016	-0.025 *	-0.022	0.015 *	0.013	0.006	-0.008	0.002	-0.017	-0.022	-0.029
Artisan	-0.011	-0.019 *	-0.019	-0.060	0.004	0.008	0.013	-0.021	-0.024 *	-0.013	-0.013	-0.013
Laborer	0.001	-0.011	-0.014	-0.009	-0.012 *	-0.029 ***	-0.007	-0.017	-0.020	-0.018	-0.019	0.010
Retired	0.079 ***	-0.018	-0.002	0.047	0.071 **	-0.005	0.003	0.038	0.168 ***	0.042	-0.003	0.067 **
Unknown	-0.002	-0.002	0.014	0.069 *	-0.001	-0.003	0.047	0.106	-0.009	-0.009	0.038	0.129
Dep. Var. Mean:	0.060	0.087	0.143	0.126	0.071	0.116	0.139	0.157	0.280	0.397	0.436	0.469
Sample Size	11954	6734	5572	2847	11954	6734	5572	2847	11954	6734	5572	2847
Pseudo-R^2	0.0078	0.006	0.009	0.0315	0.001	0.014	0.01	0.021	0.014	0.011	0.014	0.012

Notes: The Marginal effects are calculated as the the change in probability resulting from a discrete change in the dummy variable from 0 to 1, holding all other variables constant at their sample means. P-values are indicated by: * p<.1; ** p<.05; *** p<.01

point in time. For instance, it is surely the case that it is the occupational history that affects the risk of disease for an individual. This exploratory analysis, however, is useful in that allows us to gauge the relative importance of different factors and identify potentially important variables for future research.

Table 6 contains regression results from 12 probit regressions. Each of the four years is investigated for three general categories: any diagnosed LR condition; any diagnosed UR condition; and any DOR condition. These are the same categories as used above, and the same definitions apply to both the dependent and independent variables. Regression coefficients are represented as changes in the estimated probability of disease that occurs from changing the given explanatory variable from 0 to 1 while holding all other variables constant at their mean values. Asterisks represent levels of statistical significance (see table notes) based on heteroskedasticity-consistent standard errors. All estimation is performed with the STATA 6 software package, including calculation of the marginal effects.

Among DOR conditions, a relatively strong age pattern exists in all four years, whereby age is inversely related to the prevalence of disease. This same pattern was found in the descriptive statistics. The earlier years show a stronger relationship than later years, but the pattern persists. It would be interesting to know the composition of UR and LR conditions among the physician-rated conditions that are not further specified, since the age patterns in prevalence in modern data show varying age patterns by age. In the early 1990s, the prevalence of allergic rhinitis peaks in early adulthood (11.7% among males aged 18-44) and declines thereafter (6.6% at age 75 and older). Sinusitis, on the other hand, peaks in the 45-64 age group and then declines. LR conditions rise much more sharply with age, but COPD prevalence falls in the 75+ age group, whereas asthma stays relatively flat across age groups. What we see with the UR and LR categories is broadly consistent with the modern age patterns, particularly the sharp decline in LR conditions in the latter ages in 1905 and 1910 and the generally negative relationship between age and UR disease prevalence.

Among the other covariates estimated, region is again the most pronounced, with the regional patterns highlighted earlier still prominent when controlling for other factors. Relative to the Mid-Atlantic states and Western states, the New England region has sharply lower prevalence, as measured with DOR, while the north central and southern regions have much higher prevalence. It is apparent that much of the regional variation is due to upper respiratory conditions. There is some variation in LR conditions, however. In 1895, LR condition prevalence is significantly higher in the North Central regions, the though magnitude of the differences are not large. The final region on Table 7, which includes veterans living in foreign countries or cases where the residence is not available from the surgeons' certificates have notable higher rates of respiratory disease, especially in the latter periods, though no obvious explanation exists for this occurrence.

Table 6 reiterates the patterns shown in the descriptive statistics for population. For DOR conditions there is no clear pattern. Large cities have the lowest prevalence, but smaller cities (25-99,000) have lower rates of disease than the mid-size (100-499,000) cities, even though both categories are lower than the rural (less than 25,000) locales. Because the low rate prevalence in large cities seems to be attributed to UR respiratory conditions, it is possible that the low rate in cities is really a regional effect, since many of the cities are in the Northeast, which has lower rates of UR disease. For LR conditions, the pattern in 1905 and, particularly, in 1910 shows a direct relationship between city size and prevalence, if we ignore the rural category.

Obviously a key missing variable in the analysis of population and prevalence is mortality, both cause-specific and in general. Since the prevalence of disease is the product of incidence and duration, it seems likely that the prevalence of respiratory conditions in the cities is suppressed by the high mortality in the cities from a number of causes. Also, it should be emphasized that the sample under consideration is *not* in any way a representative sample of city residents during this time period because the sample observations are veterans of the Civil War. While these veterans may have breathed the same air as typical city residents when the walked outside, their lives were likely to have been different in many ways—including their places of employment and the public sanitation in their neighborhoods—than the typical residents of the large cities, a large portion of which were recent immigrants. An interesting project for future research is a comparison of the socioeconomic differentials between the Union Army veterans living in large US cities and the city population at large.

Finally, mortality is also probably the reason why farmers have higher rates of disease than do other groups, particularly the professional/proprietor group, artisans, and (in most cases) laborers, though differences are generally not statistically significant. The only group that has consistently higher prevalence than farmers is the retired group, though this is problematic since higher rates in this group are likely due to age. This may also reflect the fact that very poor health induces retirement in some cases. As noted earlier, more research needs to be done on tracing the occupational history of veterans and further refining the artisan and laborer classes to identify workers who may have faced particularly high rates of occupational lung diseases.

6. Conclusions

This research explores demographic patterns associated with different categories of chronic respiratory disease for the period 1895-1910. A central finding is that the age-specific prevalence of respiratory disease (as measured by the percent of the sample ever diagnosed) among the veterans of the Civil War increased sharply between 1895 and 1910. This trend holds true both for UR and LR conditions and for the specific conditions of asthma and COPD. The sharpest period of increase was between 1895 and 1900, but steady increases occurred after 1900 as well. For instance, the prevalence of the most general category, DOR, increased over the 1900-1910 interval from 37.8% to 47.4% among the 60-64 year old group, from 34.9% to 46.2% for those 65-69, from 37.6% to 46.7% for those 70-74 and from 34.0% to 49.2% for the 75-59 year-olds.

Changes in the pension law induced significant changes in the number of veterans applying for and receiving pensions assistance. Therefore it is important to consider legal changes when using the medical data. The most important change occurred in 1890, when disabled veterans were allowed into the system even if their disability was not war related. However, between 1890 and 1907, there were no major changes in the law. It may be true that as the veterans aged and their health deteriorated, the system became increasingly lax or that *de facto* age-based pensions were given, but the increases reported above are age-specific changes, not within-cohort increases (though within-cohort rates increased as well). Thus for most of the period under study the eligibility requirements seem to have been stable, suggesting that the upward trend is not merely an artifact of legal changes in the pension system.

Earlier I identified four factors that suggest increasing prevalence of respiratory disease (in particular LR conditions) over this time period. These factors are 1) increased exposure to infectious disease due to rapid urbanization (though public health programs likely mitigated the effect of population growth); 2) decreased indoor and outdoor air quality rising from a booming and unregulated manufacturing sector; 3) the rise of mass-produced cigarettes in the 1880s; 4) a deterioration in childhood health and nutrition as reflected in the declining heights in successive cohorts within this study. At this point, these are merely conjectures, since I have not, as yet, accumulated evidence on patterns of cigarette consumption, nor have I incorporated the detailed manufacturing and occupational data that would be necessary to make inferences about air quality

Exploratory analysis of the primary demographic variables present in the surgeons' certifications does reveal a few significant patterns. Regional variation in UR disease reflects roughly the same pattern as found today. New England states had significantly lower prevalence than other groups, while the Southern, Western and Midwestern rates significantly higher. This same general pattern was found for LR conditions as well, with the exception of the Southern and Borders states, where the rate was much lower. Surprisingly, the prevalence of both UR and LR conditions was much lower in cities (especially those over 500,000) than in locales of fewer than 25,000, though this is likely due to differences in mortality. Within cities of over 25,000, however, the rate of LR disease rises significantly with population. This suggests the impact of air pollutants in the larger cities. Finally, occupational variation was slight, but laborers did have consistently higher prevalence of LR disease than artisans or professionals. Farmers had higher prevalence, but again, lower mortality among farmers is likely responsible.

The uncertain impact of differential mortality across demographic subgroups is an example of the fact that this analysis of course raises far more questions than it answers. While there are some inherent data constraints, such as a lack of air quality measures, there is still an abundance of data in the massive AVUA collection that remains to be exploited. As previously mentioned, much more work can be done with occupational classifications, and early life characteristics, available on a portion of the sample that was linked to the 1850 and 1860 census manuscripts, can be incorporated. Costa's (2000) recent study highlights the importance of exposure to infectious disease during the Civil War. And, perhaps most importantly, the impact of other diseases the veterans may have had needs to be incorporated to understand the etiologies of respiratory disease. Clearly a next step is a detailed longitudinal analysis of all these potential risk-factors for respiratory illness using the disease classifications I have developed.

The results presented here will hopefully spur further research investigating the epidemiology of chronic illness during this critical time in American history. Recent research has highlighted the decline in chronic illnesses over the twentieth century. This study suggests that, at least in the case of respiratory disease, any decline in age-specific prevalence rates must have begun to occur some time after 1910, since the evidence presented here suggests a sharp rise in the years prior to 1910. The work of Robert Fogel in recent decades has emphasized the secular improvements in health over recent centuries. This study suggests the importance of reference points when making these long-term comparisons. Previous research on the decline in chronic illness over the past century has typically used 1910 as a reference point.[23] In the case of respiratory disease, the reported declines would be much more modest if an earlier reference point, say 1895 or 1900 had been used rather than 1910.

At the very least, the research presented here reflects both the challenges and the importance of understanding the relationship between economic development and health. Respiratory disease, in both acute and chronic forms, remains a significant public health concern today. The past decade has seen a sharp rise in the prevalence of asthma, and epidemiological research has linked even minute particulates in the air to respiratory disease, causing a vigorous public debate over EPA air pollution standards concerning fine particulates. Further investigation of respiratory illness in this dynamic period of American economic history promises to illuminate further the relationships between health and economic activity.

[23] See Fogel and Costa (1997), for example.

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