The Problem of Excess Female Mortality: Tuberculosis in Western Massachusetts, 1850-1910

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THE PROBLEM OF EXCESS FEMALE MORTALITY: TUBERCULOSIS IN
WESTERN MASSACHUSETTS, 1850-1910

A Thesis Presented

By

NICOLE LORAINESMITH

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
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Department of Anthropology
THE PROBLEM OF EXCESS FEMALE MORTALITY: TUBERCULOSIS IN WESTERN MASSACHUSETTS, 1850-1910

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DEDICATION

To my daughter, Dwana, may you live a long and healthy life.
ACKNOWLEDGMENTS

I would like to thank my committee, Alan Swedlund, Lynnette Leidy Sievert, and H. Martin Wobst, for their tremendous amount of patience and support. I would also like to thank Alan, Lynnette, and Martin for the knowledge and wisdom they have shared with me, which has touched my life on so many levels from anthropological thought, academic and career development, to family and friends. Thank you.

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ABSTRACT

THE PROBLEM OF EXCESS FEMALE MORTALITY: TUBERCULOSIS IN WESTERN MASSACHUSETTS, 1850-1910

MAY 2008

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Under the modern mortality pattern females die at all ages at a lower rate than males. However, this was not always the case. For much of the nineteenth century in the United States and parts of Europe it appears that females died at a higher rate with respect to at least one disease, pulmonary tuberculosis. The purpose of this research is to investigate this question in four towns of the Connecticut River Valley, Massachusetts. First, it is necessary to establish age- and sex-specific mortality rates in the four rural towns in the Connecticut River Valley during the latter half of the 19th century and beginning of the 20th. Secondly, it is necessary to identify those cases in which tuberculosis was the main disease and cause of death. This research seeks to discuss and contribute to the topic of excess female mortality. The four Massachusetts towns of Greenfield, Deerfield, Shelburne, and Montague constitute my research sites. These towns are appropriate for the anthropological pursuit of historical epidemiology due first to the towns’ rural nature at a time when the majority of Americans lived in rural towns, not large urban cities where studies are often focused. Secondly, these towns are of interest because of the extensive data collection that has been conducted previously. Tuberculosis (TB) is an interesting and instructive disease to focus research on. TB has
re-emerged in recent decades, and research on the disease may have applied implications and value. TB was the number one killer during the study period, and the nature of the disease is such that it is very sensitive to the social environment. The combination of a rural setting and tuberculosis may give insight into the etiology of a disease that shares a long yet uneven history with humans, and has both biological and cultural significance.

Under the traditional mortality pattern females of particular age ranges have greater mortality rates than males. This research discovered that females exceeded males in mortality rates at ages ten to 19 and 30 to 39 and that TB was the root cause of greater female mortality. Interestingly, the sex-specific gap in TB mortality rates was much wider than the gap in overall mortality rates. Thus, while females were dying of one cause, evidence shows that males were dying of another, which may have offset male TB mortality rates.
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CHAPTER 1

INTRODUCTION

Statement of Problem

The main objective of this thesis is to determine tuberculosis mortality rates among the study population, with primary interest in age- and sex-specific tuberculosis mortality. A further objective is to offer plausible explanations for the tuberculosis mortality pattern. These objectives warrant anthropological investigation because of the deep impact tuberculosis has had on the human species, because of the impact on human populations that is still to come, and because research at a micro-level is lacking in the current literature on historical tuberculosis due to the rarity of available data.

Writings on tuberculosis go back as far as Hippocrates (Dormandy 2000), and evidence of the disease is clear in prehistoric old and new world mummies (Dormandy 2000; Gomez i Prat and Mendonca de Souza 2003). Yet the disease is still elusive, and an understanding of the disease is still sought on many different levels. The search for knowledge on the disease ranges from archeological pursuits to medical ones (Wilbur and Buikstra 2006). This research is focused on the historical epidemiology and social etiology of tuberculosis at a micro-level.

In 1936, Frost (1940:62) said, “If we could accurately interpret [the tuberculosis age-specific mortality record], analyzing in detail each movement upward or downward and assigning to each factor its due share in the change, then we would be well on the way to knowing the epidemiology of tuberculosis.”
While the proximate cause of TB, the bacteria *Mycobacterium tuberculosis*, has been determined (Barnes 2000; Koch 1932), the ultimate risk factors for active TB infection are still widely researched and debated (Barnes 2000; Davies and Grange 2001). These ultimate causes include political-economic, environmental-historical, and culturally mediated factors, which determine exposure to the pathogen and the competence of the host’s immune system (Baer et al. 2003; Swedlund 2000). Understanding the factors that led to disease and mortality in the past is a major resource for understanding disease today and presumably in the future (Landers 1992).

**Tuberculosis in the 20th Century**

Tuberculosis (TB) is an infectious disease. However, that was not established until late in the 19th century, and it was not widely accepted until the beginning of the 20th century. “Doctors trained in the ‘scientific truths’ of the Great Tradition held that most diseases were caused by miasmas, undisciplined life-styles, and anything other than tiny *living* organisms” (Watts 1999:xii).

During the mid 20th century, TB was believed by many in the United Stated to be a disease of the past that had been conquered by increased living standards, public health, and medical measures such as antibiotics. Unfortunately in the mid 1980’s, tuberculosis rebounded as an infectious disease of great concern in the West, while in the developing world, TB has had a continuous presence (Farmer 1999).

The resurgence has been linked most prominently with the surge in HIV/AIDS, due to the effects of immune suppression (Dormandy 2000). However, TB resurgence has also been linked to homelessness and a decline in TB awareness and control (Brudney...
and Dobkin 1992; Farmer 1996). Further, TB has rebounded in an antibiotic resistant form.

Following the rising numbers of HIV/AIDS and tuberculosis cases in the 1980’s, the hypothesis of a third epidemiological transition was proposed (Armelagos et al. 1996; Barrett et al. 1998). The third epidemiological transition encompasses three trends – first the emergence of new infectious diseases, second the re-emergence of previously known infectious diseases, and third the emergence of antimicrobial resistant strains. Indeed, the previous decline in infectious disease cases was interrupted starting in 1981 in the United States as the infectious disease death rate in 1995 peaked at 63 deaths per 100,000 from 36 in 1980 (Armstrong et al. 1999). Major contributors to this increase were tuberculosis and the newly recognized HIV/AIDS. Additional causes included 28 other newly recognized or re-emergent infectious diseases (Lederberg 1997).

The death rate from infectious diseases has again been on a decline since 1995. However, new forms of TB continue to appear. One case made international news in June 2007 when a young American man diagnosed with the most frightening form of TB yet known, XDR TB, boarded multiple airplanes and flew around the world (Markel et al. 2007). This form, extensive drug resistance tuberculosis, is even more resistant to antibiotics than the previously identified multi-drug resistant form.

Tuberculosis never became the “conquered” disease it was predicted to be. With the disheartening realization that TB never went away and is still evolving, there has been renewed interest in the history of the disease. Studying the historical context under which TB was so prevalent in the past is important not only for preserving history but also for understanding TB in the 21st century.
Background

From historical evidence such as vital records, we know tuberculosis (or rather consumption as it was known in the past) was a leading killer in the late 19th and early 20th centuries, but its notoriety as a leading cause of death was established much earlier. In 1680, Bunyan (141) wrote of a character having many inflictions, “yet the Captain of all these men of death that came against him to take him away, was the Consumption.” Such names as ‘Captain of all these men of death’ and ‘the white plague’ (Dubos 1952) have been attributed to this disease due to its deep and multi-layered impact on the lives of the afflicted as well as on society as a whole. This makes tuberculosis one of the most important illnesses and diseases in history (Dormandy 2000).

What gave this disease notoriety was not only the number of lives it took, and the way it took them, but also who it took. In Massachusetts, public health officials in the late 19th century were well aware that the young, who should have been in the prime of their lives, were the most frequent victims of the disease. Further, it was thought that the disease brought death to young women more often than to young men (Abbott 1897). This loss of the young was also known in more distant times. For example, Dormandy (2000:2) writes, “Pale, emaciated youth, fighting for breath, coughing up blood and dying young were as common in the Antiquity world as were the wonderfully fit horsemen who parade on the frieze of the Parthenon.”

Materials and Methods

This research looks at tuberculosis mortality in Deerfield, Greenfield, Montague, and Shelburne, which are located in Franklin County along the Connecticut River Valley in northwestern Massachusetts for the years 1850 to 1910. In total 14,810 individual
deaths were recorded in the study area and period. Consumption accounted for 13.3% of these deaths, with females making up for 55%\(^1\) of consumption deaths.

Consumption was the deadliest disease throughout the study period. Samuel Abbott wrote, “consumption has from the outset, [1856\(^2\)], maintained the first place as the most destructive cause of death. The uniform diminution, however, in the mortality from this cause gives good reason for believing that in a very few years it will have disappeared from the head column” (1897:759). Hope for a diminishing death rate due to tuberculosis is seen even earlier. Directly after the bacillus that causes the disease was discovered, an article in the London *Times* proclaimed that “we come into manifest contact with the high probability that the thousands of human lives which are now sacrificed every year to the disease produced by bacilli may at no distant period be protected against these formidable enemies” (Tyndall 1882:5). By 1915, the vital statistics of Massachusetts do in fact confirm Abbott’s hypothesis; however, consumption remained the deadliest *infectious* disease and was only second to heart disease when considering all diseases during the early 20\(^{th}\) century in Massachusetts (Massachusetts 1915).

This analysis seeks to contribute to the epidemiology and the social etiology of tuberculosis by establishing sex- and age-specific trends in tuberculosis and by discussing plausible causes of those trends (movements upwards and downwards) using historical epidemiology as a bio- anthropological approach at a micro level.

\(^1\) Women accounted for, on average, 50% of the population.
\(^2\) 1856 is the first year of Abbott’s forty year summery of the vital statistics.
This approach, as explored and discussed by Swedlund and Donta (2003), necessitates a holistic assessment of the disease. In order to gain a broad perspective “four domains of interest” are utilized. These include:

1) Historicity, when and where is the epidemic of interest taking place and what is the situation, socially and economically.

2) Medical history, in the same vein as the above domain, what is the situation medically.

3) Biology, what is our modern knowledge of the pathogen and host interaction.

4) Epidemiology, using modern knowledge, what do the historic data reveal?

The use of 1, 2, and 3 form the keystone to explaining 4.

Mortality rates are often used to evaluate a society in terms of its overall health, well-being, experience, and social characteristics. Tuberculosis is an especially important disease in studying the human condition because it is particularly sensitive to environmental and social conditions. But death statistics do not tell the whole story. Unfortunately, morbidity statistics are not available for this population. While I can say with relative confidence how many young women died in a month, year, or decade, I can not say how many young women, or men, were ill, moderately or debilitatingly so. Hardy (2001:10) notes that the mortality record “does not reflect health during life, psychological fitness or social well-being, and…there may be a difference in health experience between social or income groups that diverge from the pattern of mortality.” Today, tuberculosis morbidity is a great concern and recording every incident is of state, national, and international concern (Centers for Disease Control and Prevention Division
Why Massachusetts and These Four Towns: Study Population

The Massachusetts vital statistics of the 19th century are unique in the United States with only Utah having had comparable individual-level data, and only Massachusetts having had a system to collect secular death records (Anderton and Hautaniemi Leonard 2004). Most often the Massachusetts records contain at a minimum the name, sex, age, cause of death, date of death, place of birth, and occupation of each individual death, and nearly every individual death in these four towns between 1850 and 1910 was recorded (McArdle 1986). This detailed record keeping was a result of the Massachusetts General Court enacting a law in 1842 which required town clerks to record the name, age, sex and cause of death of the deceased as reported to them by the attending physician or town’s people\(^3\). Revisions to this law occurred often and other advances in vital statistic registration were made. In 1869, the first State Board of Health was established, and later, local health boards were established in each city and town creating an array of records for research. In 1878 it was passed that every death should be recorded along with the cause of death as established by a physician, if one be present, before burial was to occur (Anderton and Hautaniemi Leonard 2004; Gutman 1958; Gutman 1959).

Not only do the records exist in their original form, but extensive demographic research has already been done on these four towns, resulting in an electronic database containing every recorded death in the four towns including all subsidiary information.

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\(^3\) This implementation lagged behind England by five years, where in 1837 the General Register Office was established.
The database has been compiled by the Connecticut Valley Demography Project (i.e. Swedlund et al. 1976).

These four towns are of particular usefulness in historical research because 85% of the US population lived in rural areas in 1850, areas which would have been similar to the areas discussed here – “relatively healthy places to live. Unlike in the Third World today…Mortality was lower and life expectancy higher in rural areas than in big cities. In this sense, to investigate nineteenth century mortality in rural America is to view not the backwater but the mainstream” (Swedlund Forthcoming, Chapter 1). Indeed, the death rates for the four towns were consistently lower than for the state as a whole.

The time of these death records corresponds to the time of the Industrial Revolution, changing conceptions of disease, but perhaps not changing disease rates. “New England’s mortality plateau, with continuing high levels of epidemic and infectious disease, provides an opportunity to study the forces maintaining high mortality…”(Anderton and Hautaniemi Leonard 2004:114).

Research into disease not only reveals the pattern of diseases but “it variously casts light on the evolution of a country’s government, institutions, on its population history, on its intellectual development, and on its social attitudes and popular beliefs” (Hardy 1993:2). These complex social and economic determinants at play have led social and economic historians to the places where TB epidemics occurred (Jones 2001).

**Historicity**

The study period is inclusive of the 61 years from 1850 to 1910, a period of agricultural transition and emerging industry. “During the nineteenth century the
Connecticut River region saw the penetration of capital and the increased proletarianization of the work process” (Abel 1987:57).

**Economics: Agricultural, Commercial, and Industrial**

Extensive research on the study area’s economics and demography has been done by McArdle (1986) and Abel (1987). Before industry took root in Western Massachusetts, subsistence and small scale commercial agriculture were the mainstays of the community, and the manufacture of many needed items was done in the home. With advances in transportation and manufacturing, these insulated, largely self-sufficient communities evolved into cash crop and factory economies. During the study period, each town had elements of agriculture, industry, and commercial enterprises at varying levels. For instance, Deerfield was more agricultural with its fertile floodplains. Greenfield was more commercial, it being the county seat of Franklin County. Shelburne and Montague were more industrial due to the Shelburne Falls and Turners and Millers Falls that supplied energy for the mills in these towns (Ginsberg and Swedlund 1986; McArdle 1986).

In the beginning of the study period, men were predominantly involved in agriculture or manufacturing. Over the study period, male occupation in agriculture declined (27.3% in 1875 to 16.5% in 1905) as a percentage of the total workforce, and male occupation in manufacturing increased (26.8% to 44.1% respectively). Trade and transportation occupations were also growing during the study period, accounting for 10.4% of the workforce in 1875 and 27.3% in 1905 (McArdle 1986:60-2). The number of individuals in the work-force as self-employed was diminishing during the 19th century.

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The information used to look at the historicity of the area will be derived mostly from these two sources.
In 1780, the self-employed made up 80% of the work force. By 1900, that proportion diminished to 30% (Abel 1987:187).

“The development of industrial core areas and the demand for labor is exhibited in occupational shifts. During the 19th century there was a shift away from household commodity production to centralized factory production. The occupational shift is observed also in the decline in the proportion of individuals in agricultural occupations and an increase in the number of individuals in manufacturing occupations” (Abel 1987:126)

**Women and the Labor Force**

Women’s occupational trends are not as easily estimated as men’s, as they were inadequately recorded in the censuses. Women were more likely to be employed part time or seasonally, but women did make up a significant portion of the work force. Women were particularly employed in factories as well as in education, government and professional categories (McArdle 1986). According to the 1860 U.S. Census of Manufacturing, 28.4% of the manufacturing labor force in Franklin County was made up of women (as cited by Abel 1987:58).

According to Abel, women became involved in the manufacturing labor force by either intensification of household commodity production or entrance into wage labor. “The initial restructuring of the labor process intensified women’s home production and their labor became integrated into capitalist social relations prior to the establishment of full-fledged factory production” (Abel 1987:186).

Household manufacturing diminished considerable by the mid-nineteenth century, a time that “witnessed an evolution and an adaptation of household production to
capitalist development.” “The household and the labor of women were not situated outside of capitalist social relations” (Abel 1987:57). The transition to factory production amounted to the proletarianization of women’s labor. Around 1830, “access to the means of production in the household [was] removed to the factories, [and] women became wage laborers in the region’s textile mills. Although women’s wage labor in these factories did not reach the scale of the eastern Massachusetts textile mills, women formed a substantial proportion of the wage laborers in these early textile mills” (Abel 1987:53).

Over the study period the proportion of women in the mills declined. Women’s proportion in the manufacturing labor force was reduced to 20% in 1880 based on the 1880 U.S. Census of Manufacturing (as cited by Abel 1987:63). Men became more suitable to mill work due to The Ten-Hour Law, which the State of Massachusetts passed in 1874, restricting the working hours of women, and children less than 18 years, to ten hours a day.

Due to the long and rigid work hours placed on women in the cotton mills, single women were the ones most often employed there. Labor participation in paper mills was more compatible to females’ schedules than in cotton mills. Work in the paper mills was more independent and hours were shorter, often less than ten hours a day. Thus married women tended to work in paper mills.

The labor force participation rate for females in Montague was documented as 23.8% of women in 1880. Just over half (55.8%) of single women are documented as in the labor force, and 10.1% of married women are documented as in the labor force. Abel (1987) adjusted for discrepancies in the records by including the expected number of married women who kept boarders or participated in farm labor. Abel estimates that
34.1% of married women participated in the labor force in Montague in 1880. “Increased industrialization created demands for factory labor as well as labor in providing lodging for the industrial labor force and increased the demand for farm produce for the market” (Abel 1987:114).

During the study period, there was a substantial decline in the total and per capita value of household manufacturing, declining from $0.21 per capita in 1850 to $0.05 in 1870 (Abel 1987, Table 5.1). “By the mid-nineteenth century, women’s household commodity production was diminished considerably. With the removal of the primary production process to the factory, the proletarianization of women’s labor was completed” (Abel 1987:210). This had a substantial effect on who could participate in production. “Whereas, household production could be done by women of all ages, married or single, industrial production demanded specific types of female labor” (Abel 1987:188). The shift of household production to factory was accomplished in increments. The skill in textile making was lost gradually but the deskilling of the process occurred before the entire manufacturing process shifted to the factories, and “women [became] the first proletariat in the United States” (Abel 1987:184).

Franklin County had three primary industries: cotton, paper, and cutlery. All three were present in the study area. Shelburne’s industry was cutlery while Montague had all three industries present. In terms of labor force participation among males and females, females made up approximately 50% of the cotton and paper labor force and less then 10% of the cutlery labor force. Thus Shelburne would have offered very little employment opportunities for females while Montague offered employment opportunities for males and females.
The increasing industrialization of the study area can be seen in the changing population structure.

**Demographics**

The population of the study area, county, and state were growing during the study period. As is the case in most measures, the study area’s population growth falls between the levels of the state and the county. The demographics of the four towns are comparable to the state and county demographics and provide a representative sample.

The study area saw a 170.7% increase in its population, the county and state saw 41.2% and 300% respectively (McArdle 1986). Growth in the study area was sporadic as compared to the state, which had a more linear pattern of population increase. Since the majority of the population of the county resided in the study area, the growth seen in the county was almost exclusively due to growth in the four towns.

“One way the demand for labor can be illustrated is to examine the increase in foreign born populations in relation to economic change” (Abel 1987:124). Immigration was occurring at a fair rate in the study area. The area’s immigrant (those born outside the country) population rose less than the state but more than the county. As with the county, state, and country, the study area’s immigrant population rose over time. In 1855, 13.4% of the study area population was made up of immigrants, which rose to 21.5% in 1905. However, virtually all this growth occurred in Montague due to its factory villages.

“The development of core areas of population density characterized the industrialization of the region” (Abel 1987:129).

Montague’s immigration population started out at 3.7% and soared to 31% by 1905. For comparison, the state levels started at 21.7% and rose to 31.5%. The level of
emigration from different countries varied over time but primarily included England, Germany, Ireland, Canada, and eastern European countries (McArdle 1986).

Immigration into Montague between 1870 and 1880 was virtually the same for males and females with females representing 47.3% of immigrants in that decade, which speaks to Montague’s labor market and high demand for female workers (Abel 1987:131). Considering both native and foreign born populations during the study period, male to female sex ratios were fairly even and stable ranging from 96.2 to 102.3 males per 100 females5 (McArdle 1986).

Median age for the state, county, and study area increased slightly during the study period, and the three areas clustered together very tightly. In the study period, the median age was 23.9 in 1850 and 27.6 in 1910 (McArdle 1986).

General Fertility Rates in the study area follow similar trends as the state, and decrease over the study period with fluctuations. A major decline occurs between 1850 and 1865 (127.0 to 94.3 per 1,000 females aged 15-44). The 1870’s saw a rise in general fertility rates (up to 102.5 per 1,000). The 1880’s again saw a decline (down to 98.8 per 1,000). The study period ended with a general fertility rate of 102.7 per 1,000 in 1910 (McArdle 1986, Table 12).

“Few statistically significant differences could be found among the three, [the state, county, and four town study area] populations examined. This lack of significance supports the contention that the study area can be used as a representative sample of Massachusetts” (McArdle 1986:89-90).

5 Excluding 1865, this had a sex ratio of 94.9, due to the consequences of the Civil War.
TB Understanding and Perception among the Populace

In his forthcoming book, Swedlund discusses in detail the social and personal experience of tuberculosis in the study area. I will review it and the work of Sheila Rothman (1994) briefly here.

TB is often a chronic disease with ‘the consumed’ living for years and even decades with the disease, going in and out of remission. Thus, the personal tale of it is rich, touching, and very emotional (Rothman 1994; Swedlund Forthcoming). The personal experience and conception of the disease is an important piece of the story when telling the history of the disease. Concepts of disease change in space and time, as well as according to one’s place in space and time, and thus, “to ignore the frame in which a disease is defined and treated is to ignore the powerful interplay between medicine and society” (Rothman 1994:3).

The people of 19th century New England had first hand experience with the disease and with death from it, for the ill were most often cared for and died at home. These New Englanders knew well the symptoms of the hollow cough, often tainted with mucus or blood, the fragile body, pale and sometimes blushed, and the sweats and fevers that came and went, as well as with the body that was literally consumed and looked already as a corpse before death arrived (Rothman 1994).

As devastating and often debilitating as these symptoms were, they were not in most incidences constant. The ebb and flow of the illness led to a life of constant uncertainty. Because the disease could go in and out of remission, the sick and those close to them had to go on living never knowing when or if the disease would alter their lives.
The inconsistency of the illness allowed the lives of the afflicted to often regain some normalcy and they were often encouraged to go on about their lives. Particularly in the beginning of the research period, the completion of life duties was encouraged, including marriage and children. Indeed, women and men often married while ill with consumption, and there are many accounts of a consumptive newlywed dying shortly after marriage and even on the day of marriage (Rothman 1994:24, 80). In other instances, love was abandoned (Swedlund Forthcoming, Chapter 5). On this point it is especially important to note how the disease and society structured the lives of consumptive men and women. Both men and women were given the prime responsibility of healing themselves. Given their fragility, they were often excused from regular responsibilities such as earning an income or fulfilling their family obligations. But they should do everything to heal themselves. That is to say middle and upper class men and women who could afford time to heal. In the first half of the research period, women were encouraged to stay home in order to accomplish health and to do their best with their domestic responsibilities. Men on the other hand were encouraged to travel by land or sea to search for health. These assignments changed in the second half of the study period as sanitariums became popular.

Childbearing is an especially interesting companion to TB in historical research, as childbearing and breastfeeding often weakened the mother. Personal accounts of motherhood and consumption have been discussed by Rothman (1994) and Swedlund (Forthcoming, Chapter 6). This point is detailed by the life of Deborah Vinal Fiske of Amherst, Massachusetts. She herself was born to a consumptive mother who died while Deborah Vinal Fiske was only in her second year of life. She too married and gave birth.
Deborah did live; however, her health had been impaired. As she was unable to breastfeed, her first child died as an infant. Deborah gave birth to four children, two of which passed away as infants. She was weakened by pregnancy, birth, and breastfeeding. She was expected by her husband to be at home mending clothes and taking care of the house. She longed to have an orderly home, but her condition made her weak. And the possibility of death or incapacitation consistently loomed over her. Deborah Vinal Fiske died of consumption 15 years after the birth of her first child.

Many women followed in the steps of Deborah Vinal Fiske, having multiple children yet being unable to fully care for them and losing many of them, or in the steps of Marietta Hoyt Ashley of Deerfield who died shortly after birth along with her baby boy (Swedlund Forthcoming, Chapter 6). Women of the time were knowledgeable about the fate of consumptive mothers and feared it greatly, as did the wife of Amherst Professor Edward Hitchcock, Orra, who wrote to Deborah Vinal Fiske that she sympathizes with her deeply, “for many thoughts which may be passing through your mind have so lately occupied my own, viz consumption which may be marching forth [through] this land to seize me with that firm grasp which will surely (though it may be slowly) lead me to my grave” (as cited by Rothman 1994:14).

Childbearing and consumption were the two greatest threats to the lives of women aged 15-50 and “they were not necessarily independent of each other either. An otherwise healthy woman who might normally have recovered from exposure to tuberculosis could be weakened by multiple or difficult childbirths and therefore be more likely to succumb to tuberculosis. Conversely, a consumptive mother, already weakened, was more

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6 Quoted as “by own” in Rothman
susceptible to physical stress, infections or the trauma of a difficult birth” (Swedlund Forthcoming, Chapter 6).

Although many “cures” for consumption were available for purchase, the most common antidote known by lay persons and physicians alike was fresh air and plentiful nourishing food. This is what the sanitarium offered.

Swedlund writes of a young women traveling to and having extended stays at TB sanitariums in New York as early as the 1830’s. However, the concept and building of TB sanitariums really took off in the late 19th and early 20th centuries. One well known TB sanitarium, the Adirondack Cottage Sanitarium, was established by Edward Livingston Trudeau in 1884. This sanitarium still does research on the disease as the Trudeau Institute.

The popularity of TB sanitariums established one treatment location for both men and women, where before men often traveled and women stayed home. However, mothers staying at a TB sanitarium, as with the mothers who stayed home or with other family in the earlier period, still fretted over the future of their children. Agnes Gordon Tack stayed at “Dr. Trudeau’s institute,” at Lake Saranac in the early 20th century, leaving her two children without a mother. Unlike the previous accounts, Agnes was lucky enough to return home healthy to continue raising her children.

Of course not all ‘consumptives’ could afford the luxury of a sanitarium during these times. The establishment of TB sanitarium may not have narrowed the social class TB mortality divide, but it would have had an impact on sex disparities, since men and women began to receive similar treatments. This evolution of ‘medical’ and social
practices is important to keep in mind when viewing and interpreting the TB mortality trend, as are all changes in such practices.

**Medical History**

**Concepts of Disease Causality/Etiology and Treatment**

Before Koch identified the bacteria that caused the disease most often referred to as consumption, heredity was seen as the main cause of this deadly disease in the medical community. This is seen particularly well in the Fourth Annual Report of the State Board of Health (Bowditch 1873), wherein Bowditch, the leader in establishing a Massachusetts State Board of Health, presents and discusses the answers of 210 physicians to 20 questions regarding the “causes and antecedents of consumption. Of the question, “[i]s consumption caused or promoted by hereditary influences” only one physician answered in the negative. For the second and third questions regarding prevention of consumption among children hereditarily predisposed, more than half of the physicians believed it could be prevented by special means. The remaining 17 questions were concerned with lifestyle, work, and living conditions. Drunkenness, over-study, over-work, certain trades, bodily injury, mental trouble, and sexual indulgence were all seen as possible causes or promoters of consumption by more than half of the responding physicians. Just over half the respondents believed consumption could be caused by contagion or infection. While there was dissent or a mixture of beliefs regarding the influences of lifestyle and contagion, 98% of the responding physicians agreed that consumption was caused or promoted by heredity.

The severity of the disease on the human condition and its believed linkage to heredity is pronounced in Bowditch’s (1873:312) commentary, where he warns future
parents to take heed concerning their consumptive heredity as not “to produce a consumptive, wretched progeny.” He also states, “will not the state feel obligated…to restrain the marriage of persons liable to breed consumption, even if it be considered improper and contrary to liberty.”

There was a variety of ‘cures’ for consumption, but before the discovery of antibiotics in the 1940’s, there was no medical cure. The best a doctor could prescribe is what Dr. Hall in ‘Health at Home’ offers. “Let the reader feel assured that the essential elements of cure in consumption are always a vigorous digestion and an active out-door life; without these no human means have ever availed; with them permanent cures are effected” (Hall 1876:223). Of the many tinctures and cures offered, Hall offers this statement, “It is the belief of educated medical men throughout the world, that the medicine is yet to be found which has any curative effect in common consumption of the lungs, although almost every year finds a new cure and loses an old one, most of them failing to survive a few months’ trial.”

It was on the evening of March 24, 1882, that Robert Koch presented his revolutionary discovery to the Berlin Physiological Society. Koch had discovered the microorganism in diseased tissue, and he was able to isolate it, culture it, and infect healthy laboratory animals causing them to become ill with the dreaded disease (Barnes 2000). This discovery astonished the medical community, and after a short time, the prospect for a true medical cure and new hope for the future of mankind set in.

Although hope for a cure was plentiful with this new discovery, true medical advances were slow to come. Koch announced the discovery of a possible inoculation and cure for tuberculosis in 1900 called tuberculin. Unfortunately, this vaccine was an
utter failure and caused more harm than good to those who received it (Dormandy 2000). A medical cure for tuberculosis was not developed within the study period of this research.

**What Constitutes the ‘Medical Community’**

During the mid-19th century, the medical community in the United States was in its infancy. In comparison with Europe, students of medicine were poorly prepared, often spending less than half the time in lectures as European students. It was not until the last quarter of the 19th century that “the best institutions were grading and lengthening their curricula to three years, requiring evidence of preliminary education, and, led by the Harvard Medical College, abandoning proprietary status to become an integral part of a university” (Numbers and Warner 1985:117). It was not until after this time that the American medical community began participating in medical research where before it was only “systematizing and utilizing the already existing knowledge” (Campbell 1860:773; as cited by Numbers and Warner 1985).

While the United States may have lagged behind Europe in medical training and research, the four town study area did not lag behind the state in medical knowledge. It was home to a prominent physician Stephen West Williams until the mid-19th century. However, those inflicted with tuberculosis or other ailments would not necessarily consult a physician like Williams. “Medical practice in the 1870s and 1880s was virtually a free-for-all. No one approach predominated: a consumptive might consult a homeopath, allopath, hydropath, osteopath, or a practitioner of any of dozens of other more obscure medical theories” (Ott 1996:9).
In the 19th century it was estimated that 90% of Britain’s population was infected with the bacillus that causes tuberculosis (Hardy 1993). Today it is estimated that one-third of the world’s population carries the bacillus – *Mycobacterium tuberculosis*. Ninety to 95% of those infected have a latent tuberculosis infection and will never develop an active form of the disease. Those with the latent form will never have symptoms of the infection, feel sick from the infection, or spread the infection to others. Five to ten percent of those infected will have active tuberculosis. Active TB occurs when the immune system is compromised and can no longer stop the multiplication of the disease in the body. At this point the bacteria start destroying tissue, particularly lung tissue. “Left untreated, each person with active TB disease will infect on average between 10 and 15 people every year. But people infected with TB bacilli will not necessarily become sick with the disease. The immune system "walls off" the TB bacilli which, protected by a thick waxy coat, can lie dormant for years. When someone's immune system is weakened, the chances of becoming sick are greater” (World Health Organization 2008). In 2005, over 1.5 million deaths world-wide were attributed to tuberculosis.

Today, two billion people are infected with the bacillus, a small percentage will ever become ill, and only a fraction of a percent of those infected will die of the disease. “An analysis of factors determining the risk of overt disease following infection must take into consideration both the virulence of the causative organism and the immune defences of the infected person” (Davies and Grange 2001:ii24).
The tubercular bacillus can be present in so many individuals due to its ability to lie dormant, while neither being destroyed by the host’s immune system nor causing disease. This ability has made *M. tuberculosis* a very successful pathogen. When the bacillus enters a human host, usually through inhalation, it lives within the macrophages. The macrophages typically destroy foreign substances; however “*M. tuberculosis* has evolved mechanisms of evading the host immune response, including inhibition of recognition of infected cells and resistance to the antimicrobial strategies of macrophages” (Flynn and Chan 2003:453). Immunocompetent hosts mount a strong immune response when infected with the bacillus, “eliciting CD4⁺ and CD8⁺ T cells as well as antibodies specific for mycobacterial antigens” (Flynn and Chan 2003:450). In relatively healthy people this response prevents disease, or active TB. However, the immune response is not able to remove the bacillus. Thus the individual remains healthy yet infected with a deadly bacteria.

It is not until the immune response of the host is compromised and the bacillus is allowed to multiply that *M. tuberculosis* becomes associated with disease. There are two avenues in research as to why some individuals are susceptible to this disease and others are not. These avenues are possible genetic factors and environmental factors, which will be discussed in accordance with the data later.
CHAPTER 2

EPIDEMIOLOGY

Crude Mortality Rates

Relatively speaking, the four town study area was a healthy place to live. The four towns registered 14,810\textsuperscript{7} deaths between 1850 and 1910. The crude mortality rate averaged 177 per 10,000 population with a range of 146 to 197 (Figure 1). Most of this variation occurred in the first half of the study period. Much less variation is seen post 1880 when crude mortality rates remained virtually unchanged and the maximum variation was 20 per 10,000. There was a slight decrease in the crude mortality rate from the first half (average 182) to the second half (average 173) of the study period.

The four town crude mortality rates fall in between the Massachusetts and Franklin County rates (McArdle 1986). Massachusetts had slightly higher rates for most of the study period and averaged 187 per 10,000. Franklin County had slightly lower rates and averaged 167 per 10,000 population.

Abbott (1897, Table 36) reports that in 1895 Franklin County had the lowest crude mortality rate among the Massachusetts counties at 152 compared, for example, to Suffolk County at 224 per 10,000 population. Indeed, rural counties were generally better off mortality wise. Again for 1895, Abbott (1897, Table 37) states urban Massachusetts counties had a mortality rate of 196 and rural counties 174 per 10,000. Dr. William Farr of England (as cited in Abbott 1897:749) noted that the greater the population density, the greater the death rate. While this holds true for Massachusetts over space (or counties), it does not hold true over time. In urban districts, the population per square

\textsuperscript{7} Duplicates are present due to registration in two towns or by data entry error. Duplicates account for less than 3\% of the database.
mile more than doubled between 1860 and 1895, yet the crude mortality rate was the same in both years, 196 per 10,000 with some fluctuation upward in between (Abbott 1897, Table 37). Abbott (1897:749) offers sanitary conditions as the source of the stay in death rates as populations rose. On each census 1860 to 1895, urban district mortality rates were consistently around 25 points higher than the rural districts.

To put these mortality rates in a broader perspective, Willcox (1906) estimated the US crude mortality rate in 1900 to have been between 178 and 195 per 10,000 population. In line with Willcox’s estimates, The New International Encyclopedia (Gilman et al. 1906) stated that for 1900 in the US registration states, urban districts recorded a mortality rate of 186 and rural districts a mortality rate of 153 per 10,000.

Looking abroad, The New International Encyclopedia for the decade 1884 to 1893 chronicled the lowest mortality rates in England at 192 and Norway at 169 per 10,000. Norway had the lowest rates recorded in this volume. Thus, Franklin County was truly a healthy place to live registering the lowest crude mortality rate compared to Massachusetts, the United States, England, and Norway. The four town study area followed closely behind Franklin County.

**Tuberculosis Cause-Specific Mortality Rates**

Tuberculosis was the number one registered cause of death in the four town area during the study period and in Massachusetts at least from 1856 to 1895 (Abbott 1897, Table 45).
In total 1,969 deaths were attributed to TB in the study area and period, accounting for 13.3% of all recorded deaths\textsuperscript{8}. TB death rates per population and as a percentage of all deaths declined throughout the study period. The TB mortality rate remained steadily high in the first half of the study period, hovering around 33.5 deaths per 10,000 population. In the 1880’s, TB mortality rates fell drastically to 24, and the rate continued to fall through 1910 ending with a mortality rate of 8 per 10,000 population (Figure 2).

The highest TB mortality rate was recorded in 1875 with 36 per 10,000 population dying of TB. By 1910, there had been a 78% decrease with 8 per 10,000 dying of TB. The two greatest reductions occurred first around 1880 with a 33% (5% of all deaths) reduction. This occurred after an 11% (2% of all deaths) increase around 1875. A second major reduction is seen in the first decade of the 20\textsuperscript{th} century dropping by approximately 54% (5% of all deaths) (Figure 2).

Looking at the beginning and end of the study period, it is notable that TB mortality rates dropped 28 points from the peak (36 per 10,000) to the lowest recorded rates (8 per 10,000) (Figure 2), and crude mortality rates dropped 30 points (197 to 167 per 10,000) (Figure 1). Thus the substantial decline in TB mortality rates was a major contributor to the small decline in crude mortality rates over the study period. As a percentage of all deaths, TB accounted for 19.2% of deaths in the 1850’s and declined to 5.7% by 1910 (Figure 3).

\textsuperscript{8} 3.6\% (n = 539) of recorded deaths had no cause listed; TB accounted for 13.8\% of all deaths with a cause recorded.
Abbott (1897, Table 61) recorded TB mortality rates from varying European
countries and Massachusetts. Of these, England had the lowest TB mortality rate ranging
from approximately 27.5 in 1850 to 14 per 10,000 in 1895, which were also lower than
the four towns. Massachusetts also had low rates compared to the European countries
(excluding England), but had higher rates than the four town study area ranging from
42.7 in 1853 to 21.9 per 10,000 population in 1895 (Abbott 1897, Table 57).

The four towns, Massachusetts, and England all had falling TB mortality rates
during the study period. Ireland, on the other hand, started out with relatively low rates
from 1861 to 1870 at 21.9, but by 1901 to 1910 had only declined in TB mortality rates
by one and a half points to 20.2 per 10,000 population (Jones 2001:Appendix 2).

**Tubercular Nosologies**

In order to understand mortality distributions and transitions, it is important to
look at the nomenclature assigned to the particular death records of interest. The 1,969
death records attributed to TB in this analysis contained at least one of four key words in
the actual death record. The most common nosological entity used was ‘consumption’,
which accounts for 74.4% of the TB deaths in this study. The second and third leading
terms attributed to this disease were ‘tuberculosis’ (15.4%) and ‘phthisis’ (8.8%). The
remaining 1.4% was made up of the term ‘scrofula’. Before 1880, ‘consumption’ was
used over 90% of the time. In the 1890's, ‘consumption’ use was reduced to below 50%,
replaced by a combination of ‘tuberculosis’ and ‘phthisis.’ ‘Tuberculosis’ became the

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9 The term ‘tuberculosis’ was in use before the bacteria was discovered. This term was
derived from the appearance of tubercles (or nodules) in the infected tissue of TB victims
(Dormandy 2000 5, 9).
dominate term used in death records in the 20th century, nearly two decades after Koch discovered the bacteria that causes the disease (Figure 3).

In a similar manner to this research, Anderton and Hautaniemi Leonard (2004) analyzed death records from Holyoke and Northampton Massachusetts between 1850-1912. While the authors’ research objective varied from this research, their approach is of use here. The authors parsed the literal cause of death as described in the registry and assigned an International Classification of Disease (ICD code) to each death. Pulmonary tuberculosis (011) is the most frequent ICD code in each decade 1850-1912.

‘Consumption’ is the leading parsed literal cause of death until 1880 (Figure 4) (borrowed from Anderton and Hautaniemi Leonard 2004: Figure 1 on page 126). At this time ‘phthisis’ (wasting, term from the Greek) is the term of choice until the 20th century when the parsed literal cause ‘tuberculosis’ becomes prevalent.

“As we might expect, retrospectively assigned ICD codes appear to be more stable across decades than literal causes of death, which reflect changing nomenclature” (Anderton and Hautaniemi Leonard 2004:119). Anderton and Hautaniemi Leonard’s analysis shows that while the nomenclature changed over time tuberculosis disease frequency remained stable as the leading cause of death 1850-1912; although, tuberculosis did decrease from about 23% to about 7% of all reported deaths in Northampton and Holyoke.

Anderton and Hautaniemi Leonard’s (2004) findings support the combining of the literal causes of death, ‘tuberculosis’, ‘consumption’, ‘phthisis’ into one mortality cause,
‘pulmonary tuberculosis’\textsuperscript{10}, as described by the \textit{International Classification of Disease}. The use of these terms to represent one disease also has been employed in the past (e.g. Abbott 1897:795).

\textbf{Tuberculosis Cause- and Sex-Specific Mortality Rates}

In the study area and period, the causes of death categorized as tuberculosis in this analysis had a dramatic effect on the population demographically and socially. On average, there was at least one death every other week from TB and many others were visibly ill with the disease. The most common victims were young women. Considering the entire study period, females were 1.2 times more likely to die from TB than males. In total, 1072 female and 895 male deaths were attributed to TB\textsuperscript{11}.

Females had a clear mortality disadvantage until 1885. Between 1850 and 1880, females were 1.2 to 1.7 times more likely to die of TB than males. From 1885 to the end of the study period, males and females died from TB at similar rates (Figure 5). Of course for males and females to have similar TB mortality rates post 1880, female mortality rates had to fall at a dramatically steeper rate than male rates. The declination disparity occurred primarily in the 1880’s. Thereafter, male and female TB mortality rates fell at similar rates. Abbott (1897:786) noted similar trends for Massachusetts stating that TB mortality rates “show[ed] a greater improvement among females than among males.”

The decline of TB, “phthisis,” mortality rates in Massachusetts and England can be seen in Figure 6 (borrowed from Abbott 1897:788).

\textsuperscript{10} The cause of death ‘scrofula’ (tuberculosis of the lymph glands) is also used in the analysis of the four towns. The inclusion of this cause of death was also employed by Dormandy (2000) and Abbott (1897).

\textsuperscript{11} Two tuberculosis deaths did not have a recorded sex. Thus for sex-specific tuberculosis deaths, 1,967 cases will be used for analysis.
The four towns, Massachusetts, and England follow similar trends in tuberculosis declines throughout the late 19th century. However, the rates and timing of sex mortality convergence and male disadvantage appear in different decades. Massachusetts had the highest TB mortality death rates compared to the four town study area and England. The four towns were slightly better off than Massachusetts, and England had the lowest rates of these three comparison locations. This hierarchy is the same for the timing of male/female TB mortality convergence and reversal. The mortality convergence occurred in England around 1866. The reversal occurred within a few years and is defined by 1870, based on Figure 6. Johansson (1977) considers England and Whales together, and found that in the 1840’s and 50’s about eight percent more females died of TB than males. By the 1880’s the disease afflicted more males than females in England and Whales.

TB mortality convergence did not occur in the four towns until 1885 (Figure 5), and a reversal did not occur within the study period. For Massachusetts, the sex-specific mortality rate gap narrows in the early 1860’s, but the gap remains significant until the convergence/reversal in 1895 (Figure 6).

The timing of the reversal or convergence occurs first in England where the lowest TB mortality rates were seen and last in Massachusetts where the highest rates were seen. Thus, England went through the mortality transition before Massachusetts, at least in terms of TB, which was the major contributor to the transition from a traditional mortality pattern to a modern one.
On the other hand, Ireland had the lowest rates compared to the previously mentioned areas in the 1860’s. Yet, the rates remained virtually unchanged between 1861 and 1911, and the male/female convergence/reversal did not occur until the 1930’s.

**Tuberculosis Cause-, Sex-, and Age-Specific Mortality Rates**

Tuberculosis was a major disease not only for the number of lives it took or that it primarily took females, but most of all because in the 19th century, the disease took so many girls and young women, who should have been in the prime of their lives and in most instances becoming wives and mothers.

Young women of reproductive age (20-29 year old) had the highest TB mortality rate (43 per 10,000 population) (not including the elderly) and had the greatest number of deaths of all age groups \( n = 305 \) (Figure 7a and 7b). This age group alone (20-29) accounted for nearly one-third of the total female deaths from TB. When considering all women of reproductive age, said to include those 15 to 50 years of age (Dublin et al. 1949), 67% of all female TB deaths were accounted for. Tuberculosis was the cause of death in nearly half of all the deaths among females aged 15 to 29.

While sheer numbers do not always paint a clear picture of mortality patterns, here total number of deaths and per population death rates followed the same trend up until old age (60+), at which time the total numbers of deaths drop and per population death rates soared (Figure 7a and 7b). Based on the per population death rates, elderly (60-92 years old) men and women had the highest death rates of all (Figure 7a).

Females were significantly disadvantaged compared to males with 16.5% more females dying of TB than men. This disadvantage was especially crucial for girls (10-19 years old) and women up to age 39, peaking in young adulthood (20-29). The
disadvantage was reversed in middle age (40-59); however, the middle age male disparity was minimal when compared to the early life (10-39) female disadvantage. The male/female differences in old age were insignificant (Figure 7a).

During the mid 19th century, females had a significantly higher TB mortality rate than males in an array of research localities, including Massachusetts (Abbott 1897), England and Whales (Johansson 1977), and Ireland (Jones 2001). Preston (1976:91-95) reported TB mortality rates based on life expectancy rather than focusing on one study area or time period. His data indicate that the lower a population’s life expectancy the more likely females were to have higher TB mortality rates compared to males. Preston reported that for populations with a life expectancy below 45 years, females had higher TB mortality rates from ages one to 25. For populations with a life expectancy between 45 and 54.99, females had higher TB mortality rates from ages five to 25. As life expectancies improved, the age range of female mortality ‘disadvantage’ narrowed. The four town study area life expectancy ranged from approximately 42 to 52 years over the study period (McArdle 1986).

Male/Female Mortality Crossover

“A mortality crossover is said to occur when mortality curves of two populations or population subgroups intersect. At younger ages, age-specific death rates for one population exceed those of the other, with a gradual narrowing of differentials as age advances, until at the oldest ages the death rate differentials are reversed” (Elo 2001:10065).

At age 40-49 mortality crossover occurred between men and women in the four town study area (figure 7a). This age at crossover was much later than other studies have
found. Dublin and Lotka (1937), Dublin et al. (1949), and Preston (1976) found that respiratory TB deaths were greater among females up to around age 25; thereafter males had the mortality disadvantage. Although Preston’s data came from a variety of populations with similar life expectancies to the four towns and Dublin and Lotka’s and Dublin’s et al. data were from the U.S., their data were almost exclusively from the 20th century and TB mortality rates were significantly lower compared to the four town data – less than an average of five per 10,000 female TB deaths for Preston’s, Dublin and Lotka’s, and Dublin’s et al. data compared to 33 for the four town data. As will be discussed further, as time progressed and TB mortality rates fell, the age of TB mortality crossover occurred at younger ages.

As we have already seen, a dramatic decrease in TB death rates occurred around 1880. Thus, the two halves of the study period had quite different trends in TB mortality rates. This difference was also noted by Abbott (1897). When age- and sex-specific TB mortality rates are broken down into these two periods, an evolving pattern can be seen. From 1850 to 1879, females had a consistently higher death rate compared to males, except for a slight dip in female TB deaths rates between the age of 40 and 49 (Figure 8, triangles). From 1880 to 1910, females experienced excess mortality until age 30. From 30 to 39 men and women had the same death rates, and from 40 to 79 males experienced excess TB mortality (Figure 8, squares). In the first half of the study period, there was no true mortality crossover, and females had an exceptionally high mortality rate compared to males from ages 15 to 39. At younger and older ages the rates were similar for males and females. Post 1880, a true crossover was seen around age 40, TB mortality rates were significantly lower for males and females, and overall the male/female disparity was
much narrower compared to the previous period. The pattern seen post 1880 was similar to what was seen by Dublin and Lotka (1937) for 1930. Data from Dublin, et al. (1949) and Preston (1976) showed a trend still of a crossover; however, male and female mortality rates varied only slightly up to around age 30, and thereafter, the male death rates were much higher than females. The start of this trend from a traditional mortality pattern toward a modern one with excess male mortality is seen in the comparison of the two halves of the study period.

Female Marital Status and TB Mortality

Because excess female TB mortality was so concentrated in the reproductive years, this study and others (e.g. Johansson 1977) have noted the possible link between TB and the stress of child bearing. In Bowditch’s report on the “causes and antecedents of consumption” (1873) he asks, “[i]s consumption ever checked by child-bearing?” To this, around half the physicians answer yes. Many physicians went on to explain that while symptoms may be lessened during pregnancy, the disease often proved fatal after delivery. One physician wrote that consumption is “checked while with child, but rapidly advancing after the birth.” Another wrote, “I am confident that I have seen the progress of the disease checked while pregnancy lasted, some half a dozen times. On the other hand, I have seen it hastened by lactation” (as cited in Bowditch 1873:355)

As there are no data in the death records regarding a female’s history of pregnancy or parturition, marital status will be used as a proxy. Of the females listed as single or married in the TB mortality records, 55% were married. This 55% was represented almost exclusively by women over 30 years of age. The 45% of singles was made up almost exclusively of females aged 1 to 24 (Figure 9a).
These data make two significant points. Childbearing, in that it was linked to marriage, was probably not a significant cause of elevated TB deaths among 15-24 year old women, as 90.5% of deaths in this category were made up of singles. Secondly, when a woman died of TB over the age of 30, she was most likely married. This tends to support the hypothesis that childbirth could have been a strain that proved fatal for many consumptive women who were married. It also indicates that consumptive women were marrying.

Splitting the data into two phases (1850-1879 and 1880-1910), the high percentage of singles in the 15-24 age ranges remains in both phases; however, for the 25-39 age ranges significantly more single women were present in the latter compared to the former phase (Figure 9b). General fertility rates in the two study period phases also declined slightly. The first phase (1850-1879) averaged 107.9 births per 1,000 reproductive aged (15-44) women. The latter phase (1880-1910) averaged 103.1 births.

**Sex- and Age-Specific Mortality Rates**

While females, particularly girls and young women, were dying of TB in excess of males, when all causes of death are considered over the entire study period, males and females had equivalent death rates by age (Figure 10). Indeed, McArdle (1986:118) found that “[t]he differences in crude mortality rates by sex are surprisingly small”. Considering all ages and all causes of death, from 1865 to 1880, males and females had equivalent death rates (Figure 11). Once TB sex-specific death rates converge around

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12 This prompts the question, were women generally putting off marriage or were consumptive women not marrying in the latter half of the study period?
1885, males had a consistently higher death rate than females when considering all ages and all causes of death.

**Multiple Cause-, Sex-, and Age-Specific Mortality Rates**

The question as to why TB disparity between males and females existed has long been debated. Some early reasoning concluded that females were constitutionally more prone to ‘consumption’ (Johansson 1977). More recent studies have indicated nutrition, workload, work environment, and/or the stress of child bearing was the root source of excess female mortality (Johansson 1977; Jones 2001). In line with previous research, this analysis has found that young females (ages ten to 39) in the four town study area and period were ‘disadvantaged’ in TB mortality rates compared to males.

If females were dying at significantly higher TB rates, yet males and female were dying at similar rates at all age ranges when including all causes, what then was causing the male deaths?

Although at a lower rate than for females, TB was the leading cause of death among males aged 20 to 49. Males 15 to 19 years old died of TB at the same rate as they died of bodily injuries. Males ten to 15 died of bodily injury more often than TB (Figure 12a). Thus unlike females, males were dying at high rates due to bodily injury, including accidents, suicide, murder, and war related injuries. In fact, male bodily injury death rates superseded female bodily injury death rates and child bearing deaths rates combined (Figure 12b).

These findings spark a new line of questioning. Were females truly ‘disadvantaged,’ or were males simply dying of bodily injuries before the disease could consume them as it did females? New England likely followed Britain in infection rates -
“90 per cent of Britain’s population was estimated to have been infected with tuberculosis at some time, although only 1 per cent of these developed active disease” (Hardy 1993:213).

Whether or not males and females were infected with the tuberculosis bacillus at the same rate and whether males and females experienced morbidity at the same level is unfortunately out of reach in historical research as morbidity data were not systematically recorded during the study period. It is plausible, though, that to some extent male bodily injury deaths reduced male TB mortality rates by removing ‘consumptive’ males from the population before tuberculosis.

**Summary of Findings**

1) Over the study period, TB mortality declined substantially and was a major contributor to crude mortality decline. Although TB as a cause of death was reduced as a percentage of all deaths, TB remained the number one cause of death among infectious diseases throughout the study period (Figures 1, 2, 3).

2) Females had significantly higher TB mortality rates than males from the beginning of the study period (1850) to 1880. During the 1880’s, female TB mortality rates fell drastically. From the 1880’s to the end of the study period (1910), males and females have similar TB mortality rates (Figure 5).

3) When considering all causes of death, males and females have equal death rates from 1865 to 1880. After male/female TB mortality rates converge males have higher overall mortality rates (1880 through 1910). Female TB mortality decline was a major contributor to the transition from a traditional mortality pattern to a modern mortality pattern (Figure 11).
4) TB mortality was concentrated between the ages of 15 and 49. TB deaths at these ages accounted for 63.6% of all TB deaths. When considering all causes of death, this age group accounted for 25.5% of all deaths.

5) Females had greater TB mortality rates than males from age one to 39. Disparities in TB mortality rates were greatest and quite considerable between the ages of 15 and 39. The greatest number of TB deaths occurred between the ages of 20 and 29 for both males and females (Figures 7a and 7b).

6) Based on the convergence of male/female TB mortality rates in the 1880’s (and on a variety of societal changes), the first half and the second half of the study period are quite different. Between 1850 and 1879, females exceeded males in TB mortality rates at all ages except 40 to 49, where there is a slight dip in female mortality rates. Between 1880 and 1910, females exceed males in TB mortality rates, although at a lesser rate than the previous period, up to age 39. At age 40 to 49 a true crossover occurs, and thereafter, males exceed females in TB mortality rates (Figure 8).

7) Before the age of 25, marriage, and likely childbearing, is not a significant influence on female TB mortality rates. A great majority of women dying of TB from the age of 25 on were married, and childbearing was a likely influence on their condition (Figure 9a).

8) When considering all causes, female mortality rates exceeded those of males at ages ten to 19 and 30 to 39 (Figure 10,12b)).

9) The disparity between female and male TB mortality rates and female and male overall mortality rates were not equal. In fact, the overall excess in female
mortality between the ages of 15 and 19 was quite slim at 1.14 times that of males, while at the same age range female mortality excess due to TB was 2.5 times that of males. If female TB mortality was significantly greater than male TB mortality, yet overall mortality was considerably similar and male mortality was even greater than female mortality at ages 20 to 29, what was driving male mortality?

10) While females ranged from 1.3 to 2.5 times more likely to die of TB between the ages of 15 and 39, males were 5.4 to 9.0 times more likely to die of bodily injury\(^\text{13}\) in that same age range. Male bodily injury deaths peaked between the ages 20 and 29; the only age range at which male overall mortality exceeded that of females when considering the ages when female TB mortality exceeded that of males (Figure 12a,12b).

11) Even when deaths due to childbearing are included in bodily injuries for females, males were 1.6 to 3.2 times more likely to die of bodily injury than females between the ages of 15 and 49.

12) TB was the root cause of greater female overall mortality compared to males at ages ten to 19 and 30 to 39. In the intermediate ages, 20 to 29, female TB mortality was still significantly higher than males; however, male bodily injury mortality rates sent their overall mortality rates over that of females\(^\text{14}\).

\(^{13}\) Bodily injury deaths include deaths by a variety of accidents, murder, suicide, and war wounds.

\(^{14}\) Between the ages of 15 to 49, males also exceeded female mortality rates due to bacterial/viral causes not including TB. Here males were 1.2 to 1.6 times more likely to die than females. Between the ages of ten to 14, females were 1.4 times more likely to die of bacterial/viral causes than males. Other ‘bacterial/viral deaths’ is primarily represented by (in order of importance) typhoid fever, pneumonia, and diphtheria.
13) From ages 40-49, males continued to have high bodily injury death rates and also exceeded females in TB deaths rates. Males continued to exceed females in overall death rates through age 99\textsuperscript{15}.

\textsuperscript{15} 99 was the oldest age recorded in the death records.
CHAPTER 3
DISCUSSION AND CONCLUSIONS

This research has focused on sex- and age-specific mortality rates at a time of industrial revolution (1850-1910) in the Connecticut River Valley, a crucial time and place in history for studying mortality trends and transitions. As we have seen, a major mortality transition begins in the middle of the study period. Around 1880, the transition is set in motion from a traditional mortality pattern, where female mortality rates are higher at certain ages than males, to a modern mortality pattern, where male mortality is greater than female mortality.

This research has focused principally on tuberculosis (TB), as it was the number one killer during the study period and it took the lives of females more often than males, causing excess female mortality at particular ages. The objective of this research was to establish the mortality patterns, and in combination with the social history, to discuss excess female mortality.

To address these objectives, I utilized a holistic approach with four domains of interest: historicity, medical history, biology, and epidemiology. The first three domains of interest, historicity, medical history, and biology, were addressed in chapter 1, the last, epidemiology, was addressed in chapter two. I now address how the first three domains influenced the epidemiology of the study area.

I analyzed the death records of four rural towns in Western Massachusetts, Greenfield, Deerfield, Shelburne, and Montague, looking at how time, age, and sex influenced the mortality patterns. The micro-level data presented here show a clear pattern of excess female mortality due to tuberculosis from 1850 to 1880 that has been
described by Abbott (1897) and Ginsberg and Swedlund (1986) regarding the larger scale data for Massachusetts.

After 1880, the decline of tuberculosis mortality rates had a great affect on the overall mortality patterns and contributed to the transition from a traditional mortality pattern to a modern one. Females gained substantially from this decline and transition in terms of age at death and TB mortality rate. Males also experienced reduced TB mortality rates and increased median age at death but at a lesser degree than females. Over the study period females gained 30 years in median age at death (27 to 57). Males gained just under ten years (36 to 45) (McArdle 1986, Table 27).

The study period is necessarily split into two phases, pre 1880 and post 1880, due to drastic changes in the mortality pattern. These two phases in the study period prompt similar yet separate questions of the research data. First, between 1850 and 1880, why do disparities exist between male and female TB mortality rates and, to a lesser extent, overall mortality rates, causing excess female mortality? Second, between 1880 and 1910, why do TB mortality rates drop and why is the mortality rate decline so much greater for females in the 1880’s than for males.

Addressing the mortality trend between 1850 and 1880 first, there appear to be three underlying causes of greater tuberculosis mortality among females. One is the fact that males were dying at much higher rates from bodily injuries, and these deaths, mostly due to accidents, likely eliminated TB morbidity cases that otherwise would have been mortality cases. This cause makes excess female mortality more of an artifact of male conditions than a female condition in itself.
The second apparent underlying cause of greater tuberculosis mortality among females is childbearing. For ‘consumptive’ women who lived past the age of 25 and married, childbirth and lactation would have likely added a physically taxing burden that, as described by physicians of the time, often proved fatal.

The third apparent underlying cause of greater tuberculosis mortality among females is material disadvantage and physiological stress. The beginning of the study period was a time of economic transition with manufacturing and industry growing throughout the study period. These economic circumstances produced especially turbulent times for females. This underlying cause has been noted by others (e.g. Ginsberg and Swedlund 1986; Johansson 1977; Jones 2001; McNay et al. 2005). Abel (1987:200) writes “Women as the initial proletariat in the United States were the first class of workers to experience large scale deskillling of their occupations, transformation of the labor process, and new relations of production.”

Ginsberg and Swedlund (1986) put forth the hypothesis that in times of agricultural modernization, where young females contribute to the functioning of the household but typically not economically, young females would have excess mortality and that this mortality was likely due to tuberculosis. Industrialization changed the structure of the family farm – changing from self sufficiency to reliance on market activity. Farm families, with a new dependence on manufactured goods, found monetary income in the wage labor of their daughters; “locales in which females were economically valuable (the factory) became distinct from those where they were perceived as economically less important (the farm)” and “the economic value of female workers to their parents was measured by their income rather than by their household
productivity level” (Ginsberg and Swedlund 1986:422, 424). This shift affected the care of daughters, including nutrition, work-load, and state of mind.

Johansson (1977:177) found similar circumstances in England and found that “[t]uberculosis was the main cause of the unfavorable differentials of females in the five to nineteen age groups; and, since both sexes lived in the same type of housing in the same climate, the diets of the girls and/or their general states of mind must have been considerably worse.”

Regarding Ireland, Jones (2001:89) adds that while a lessened inequality between the sexes may have occurred with industrialization, her “study suggests the work environment experienced by women may have led to a short term rise in their mortality from pulmonary tuberculosis.”

As urbanization rose, TB mortality rates fell, with female rates falling faster than male rates. Jones offers the rural nature of Ireland as a source of higher female mortality overall, while the most urbanized province in Ireland, Lancashire, had consistently lower female mortality rates compared to males (Jones 2001:69). Jones notes that industry had already been present in Lancashire for over a century, so “any short term epidemic rise in tuberculosis would have played itself out” (Jones 2001:73). A similar trend is also seen in Japan (Johnston 1995).

Although the pre-1850 sex-specific death rates are not known, it appears as though the subsistence/economic transition of the mid-19th century led to a steep divide between male and female deaths due to TB. This divide flattened and reversed at varying times depending on place or, more particularly, on the phase of industry and to what extent females were valued within that phase.
If male deaths due to other circumstances, the physical burden of childbearing, and female stress and overwork caused excess female TB mortality in the first phase of the study period, what caused TB mortality rates to drop in the second phase and to be significantly greater for females in the 1880’s? The discovery that bacteria were the cause of the great loss of life and the acceptance of contagion along with increased living standards are likely substantial contributors to the dramatic decline in TB mortality rates; although, these influences would have likely impacted males and females similarly. Likewise the rise in popularity of TB sanitariums and isolation of the sick could have played a crucial role in reducing TB morbidity and mortality. Other plausible factors particularly affecting females include the passing of The Ten-Hour Law and reduced general fertility rates.

The Ten-Hour Law, which the State of Massachusetts passed in 1874, restricted the working hours of women, and children less than 18 years of age, to ten hours a day. This law played two roles. First it reduced work hours and likely the physical and psychological stress of working long hours, and second it replaced many female mill workers with men, who were permitted to work longer hours.

TB mortality rates and general fertility appear to be correlated. As general fertility fell between 1850 and 1870 so does TB mortality rates. There was an increase in both general fertility and TB mortality rates in 1875, and a decrease in both in the 1880’s. Thereafter general fertility rates rise and TB mortality rates fall, but from the beginning to the end of the study period general fertility rates drop 24 percentage points.

Whether an individual becomes ill from the bacteria is determined by that person’s immune response. Immune response is determined by disease load, nutrition
level, physical stress, and psychological state. Thus TB is a social disease. I hypothesize that girls and women in the industrial revolution died more frequently than boys and men due to mistreatment, including malnutrition, overwork, and psychological stress, and the physical strain of childbearing. Yet, the high rate of male deaths due to bodily injury exaggerated and inflated excess female TB mortality rates relative to male TB deaths.

The proximate cause of TB is undisputed. Some researchers find the ultimate causes of little concern; and thus, find only research focused directly on the bacilli useful (Carter 1991; Stehbens 1987). However, history has shown us that the efforts towards reducing the ultimate causes have been the most successful in reducing mortality rates (McKeown 1976; Szreter 1988).

A trend in greater male than female TB mortality is noted by Dublin, et al. (1949:132). In their analysis of the United States 1939 to 1941, “the ratio of male to female mortality at all ages is 1.5. This excess arises wholly from the higher male death rates at ages 25 and over; under that age, the death rates from this cause are higher for females than for males.” Thus, a female predisposition to tuberculosis, which has been proposed and critiqued by Ginsberg and Swedlund (1986) and Waldron (1982), is not plausible as over time males have become more susceptible to death from the disease.

Today, males are the primary victims of TB. This is the case world-wide with countries reporting 1.4 million smear positive cases in men and only 775,000 in women (Dye 2006). In Massachusetts, 60% of new cases in 2006 were among males (Commonwealth of Massachusetts Department of Public Health 2007). However, under certain circumstances young females are still the primary victims. This is the case in
African populations that have high rates of HIV/AIDS. In these populations young women aged 15 to 24 years old represent a high proportion of TB victims (Dye 2006).

These circumstances point to environmental dynamics rather than genetics as the influential factors causing some to have active TB while the majority of those infected remain latent cases.

**Tuberculosis in the 21st century**

Worldwide tuberculosis is the number one killer among curable infectious diseases, and new cases of tuberculosis are still on the rise in the 21st century. This rise is due to rising rates in Africa and Eastern Europe, while other areas have experienced stability or a decline in recent years (Dye 2006). While the greatest incidence rate occurred in Africa and the greatest prevalence of TB is in South East Asia, tuberculosis has again struck young females in the Connecticut River Valley. In November, 2007, twelve young women attending Smith College in Northampton were diagnosed with tuberculosis and recommended to receive a six to nine month course of antibiotics. Eleven are being treated for latent tuberculosis, and one is being treated for active tuberculosis (GrecourtGate News 2007). These twelve young women will not make a statistical difference in the approximately nine million new cases that occurred globally in 2007. However, the presence of this disease today within a small private women’s college in rural Western Massachusetts speaks to the fact that tuberculosis was never fully “conquered.”

**Implications for Future Research on the Modern Day Epidemic**

This research and others have indicated that TB is a social disease and that females were not more likely to die of TB than males because of an inherent
predisposition. This same premise can be applied between ethnic groups, which are now often the subject of TB research. Some argue that whites are less susceptible genetically or are more adapted to the bacteria due to early 19th century exposure (Davies and Grange 2001). I would like to argue that social concerns, including nutrition, workload, and psychological stress, are likely to lead to a better understanding of TB morbidity and mortality today than research based simply on ethnic origins.

Future Research on Historic Data

The historic data used in this analysis holds more valuable data than were able to be extracted in this research. Further analysis could shed light on TB mortality between women of varying labor forces, which could indicate whether females were better off working on family farms with no wage income or in the mills with a wage income. An analysis by country of origin could also prove insightful.

The study period used in this research encompassed 61 years of data. Thus, trends over time have been smoothed over as a 15 year old in 1850 is lumped with a 15 year old in 1910. To look better at temporal changes in TB mortality rates, a cohort analysis could prove useful.
Figure 1. Four Town Crude Mortality Rates
1850-1910

Mortality per 10,000 Population

Census Year, with deaths averaged on 3 & 5 year intervals around the census year
Figure 2. Four Town TB Cause-Specific Mortality Rates
1850-1910

Census Year, with deaths averaged on 3 & 5 year intervals around the census year
Figure 3. TB Nomenclatures
1850 to 1910
Figure 5. Four Town TB Cause- and Sex-Specific Mortality Rates 1850-1910

Mortality Per 10,000 Population

Census Year, with deaths averaged on 9 & 10 year intervals around the census year
Figure 6. Massachusetts and England's 'Phthisis' Mortality Rates per 1,000 1850-1895
Figure 7a. Four Town TB Cause-, Sex- and Age-Specific Mortality Rates, 1850-1910
Figure 7b. Four Town TB Deaths by Sex and Age

Inclusive Ages

Number of Deaths

- Male
- Female
Figure 8. Four Town TB Cause-, Sex- and Age-Specific Mortality Rates, 1850-1879 and 1880-1910

- Male Death Rate 1850 to 1879
- Male Death Rate 1880 to 1910
- Female Death Rate 1850 to 1879
- Female Death Rate 1880 to 1910
Figure 9a. Female TB Deaths by Marital Status
1850-1910

Number of Deaths

Inclusive Ages

Single
Married
Figure 10. Four Town Sex- and Age-Specific Mortality Rates 1850-1910
Figure 11. Four Town Sex-Specific Mortality Rates
1850 to 1910

Mortality Per 10,000 Population

Census Year, with deaths averaged on 3 & 5 year intervals around the census year
Figure 12a. Male Cause-Specific Mortality Rates
1850-1910

Mortality Rate Per 10,000

- Bacterial/Viral Mortality Rate (excluding TB)
- Bodily Injury Mortality Rate
- TB Mortality Rate
- Total Mortality Rate from All Causes

Inclusive Ages

10-14 15-19 20-29 30-39 40-49
Figure 12b. Female Cause-Specific Mortality Rates
1850-1910

- Bacterial/Viral Mortality Rate (excluding TB)
- Child Bearing Mortality Rate
- Bodily Injury Mortality Rate
- TB Mortality Rate
- Total Mortality Rate from All Causes, grey triangles indicate greater female than male mortality
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