INFANT MORTALITY IN OTTAWA, 1901:
AN HISTORICAL-GEOGRAPHIC PERSPECTIVE

by

Michael E. Mercier, B.Sc. (Hons.)

A thesis submitted to the Faculty of Graduate Studies and Research

in partial fulfilment of the requirement for the degree of

Master of Arts

in Geography

Carleton University

Ottawa, Ontario, Canada

September 5, 1997

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0-612-26933-7

Abstract

This thesis investigates the incidence of infant mortality for the city of Ottawa, Canada in 1901. Infant mortality, defined here as the number of deaths of children under the age of one as a proportion of all children in that age group, is widely accepted as a sensitive indicator of living conditions. This study shows that there is a marked concentration of infant deaths in Lowertown, the area of Ottawa shown to have the worst living conditions. Within Lowertown itself, infant deaths show only a slight concentration on a few particular block-faces and in several census divisions. The most commonly identified causes of infant death display a seasonal pattern with most of the deaths occurring in the summer months. This pattern of locational clustering and seasonality in the area with the poorest living conditions reflects the influence of environmental factors on the causes of death. However, more important than location in the incidence of infant deaths in Lowertown are the conditions of living within the home. Many of the social, economic and housing factors associated with infant deaths in Lowertown were identified. Ethnicity, religion and language were the social factors associated with infant deaths, and in particular French, Catholic and French-speaking families were more likely to have a child die than were other groups. House type, household and family size, internal crowding and external population density were the factors, related to housing conditions, most strongly associated with infant deaths. With respect to economic factors, assessed property value proved to be most important while income and occupation were found to be less strongly associated with infant deaths.

Acknowledgements

There are many people who have been particularly supportive in helping me complete this thesis and I would like to take this opportunity to thank them. First of all, I would like to thank my supervisor John Clarke. Despite a one year sabbatical and a topic somewhat removed from his central research interest, John has been most helpful, supportive and has shown great interest in my work. Thanks also to the faculty, staff, and students of the Department of Geography at Carleton University, David Bennett, Hazel Anderson and Kari McLeod in particular. Chris Boone also deserves many special thanks. Although living in southern California, his guidance, insight and support helped tremendously over this past year.

A strong support network of friends and family has also been particularly important. I especially want to thank my parents for their support and Mr. and Mrs. Rutherford for all of their words of encouragement. Also, Kate Campbell and Susie Aylard for their academic advice. Thanks to Lilja Jonsdottir, Denis Poulin and their two children for great food, good cheer and a nice place to stay on the occasional cold winter night in Ottawa. Also, special thanks to Shari Jones and Brent Darbyson for their hospitality in Ottawa while I was commuting from Hamilton. Thanks also to Angus and Andy whose company during moments of crisis was comforting.

Finally, I must acknowledge my partner and best friend, Patricia Rutherford, for without her help this thesis would never have come this far. Her countless hours spent proof-reading, editing and discussing the concepts of this thesis were invaluable. Her encouragement and belief in me has been so important. Thank you.

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Chapter One:

Introduction

Together with fertility and migration, mortality is an essential part of population growth and structure. In The Dictionary of Human Geography, Ogden identifies four areas relating to mortality on which geographers have traditionally focussed their work; the role of mortality in population change, the ways in which particular diseases are diffused, the influence of the environment on mortality and the relationship between mortality and economic and social conditions (Ogden, 1994, 398). Measures such as the crude death rate (the number of deaths per 1000 of the population in a given time period), and age-specific mortality rates (number of deaths to persons of a certain age per 1000 of the population in that age group) are most commonly used in mortality studies. The infant mortality rate is one sub-set of the age-specific mortality rates that often receives special attention.

Traditionally, the infant mortality rate (IMR) measures the number of deaths of infants under one year of age per 1000 live births in a given year. The IMR is an important indicator because of its sensitivity to social and environmental conditions (Ogden, 1994, 398). The infant mortality rate's sensitivity is a result of the youngest age-cohort's susceptibility to illnesses, in turn, influenced by poor social and living conditions. For example, infants are more susceptible to death from environmentally related illnesses like diarrhoea because of their small size and less developed immune

systems.

Other more precise measures of infant mortality are the neo-natal mortality rate (deaths occurring within the first four weeks of life) and the post-neonatal mortality rate (death occurring after the fourth week, but before the end of the first year). Some research has also focussed on the different types of diseases and illnesses that affect infants in particular. These include endogenous illnesses that result from congenital malformations and complications resulting from delivery and exogenous illnesses that result from infections, disease and poor care (Henry, 1976, 148-151). Exogenous illnesses are most influenced by environmental conditions and are more easily remedied with improvements in health care and public health and welfare services. Infants' susceptibility to death caused by environmental illnesses and the resultant sensitivity of the infant mortality rate to environmental conditions allows this measure to be widely used in the literature as a proxy for the social and environmental conditions in which infants and their families lived.¹

Mortality, and particularly infant mortality, declined throughout the nineteenth and twentieth centuries in Europe, North America and other industrialized parts of the world. There is debate over whether this decline in mortality rates was due to improved medical care or general improvements in living standards. Ogden argues that improved public health provisions, modern diagnostic and surgical techniques and inoculation programs had a greater impact on the decline of mortality rates in the developing nations of the world, than it did on the decline of mortality in industrialized countries (Ogden, 1986, 398). He goes on to argue that general

increases in the living standards as seen through improved quality and quantity of food, sanitation and housing conditions along with increased economic standards of living were just as, if not more, important to the declines in mortality in the industrialized countries than was the improved medical services (Ogden, 1994, 398).

The Epidemiological Transition Model (ETM) is a well-known theory that describes how, with modernization, the causes of death changed through time from infectious and parasitic diseases to human-made and chronic conditions (Curtis and Tacket, 1996, 82; Trovato, 1994, 23). Omran (1971) outlined three specific stages of epidemiological change: the era of pestilence and famine, the era of receding pandemics and the era of human-made and degenerative diseases. Mortality rates in Europe began to decline in the eighteenth century with the gradual disappearance of epidemic mortality from such infectious diseases as bubonic plague, small-pox and typhus and so, according to the Epidemiological Transition Model European society moved from the era of pestilence and famine to the era of receding pandemics (Curtis and Tacket, 1996, 82). Only through more efficient government intervention in eighteenth century Europe did these industrialized countries begin to see overall mortality rates approximate pre-industrial levels.

Through much of the nineteenth century, Europe was characterized by a stabilized mortality rate, where endemic infectious diseases, such as cholera, tuberculosis and 'diarrhoea', predominated largely among the urban poor; this was characteristic of the first, of two, phases of the era of receding pandemics. The second phase of this era brought on another significant decline in the mortality rate at

the end of the nineteenth century mostly through a reduction in the child and infant mortality rates. Public health and sanitary reform began to reduce the frequency and magnitude of outbreaks of 'summer diarrhoea' and other endemic infectious diseases to which infants were particularly susceptible. European rates again remained stable through much of the first half of the twentieth century with the exception of the late 1910s when the First World War and the worldwide influenza outbreak dramatically raised the mortality rates. The next major decline in European mortality rates occurred after the Second World War when the use of sulphur drugs and antibiotics became commonplace and European society moved into the stage of human-made degenerative diseases.

The United States and Canada have followed a pattern of mortality decline similar to Europe's, although the decline in overall mortality rates due to significant declines in child and infant mortality rates occurred somewhat later, and more quickly in North America than in Europe. McInnis argues that the delayed decline in child and infant mortality rates in Canada was the result of a relatively late fall in the fertility rate, as the family size, particularly in rural areas and Quebec, remained large (McInnis, 1990a, Plate 29). The proportionally high fertility rates that continued into the first decade of the twentieth century meant that mortality declines associated with improved sanitation, water and milk supplies, and smaller families did not take effect until later in the twentieth century.

Table 1 shows the infant mortality rate of select countries around the turn of the century. As shown in this table, Canada's infant mortality rate lies approximately

Table 1 - Infant Mortality Rates for Select Industrialized Countries, 1890²

Country	Infant Mortality Rate (Deaths per 1000 live births)
Canada	145
England and Wales	148
France	110
Germany	225
Italy	195
Netherlands	178
Sweden	85
United States	125

(Source: McInnis, 1990a, Plate 29)

midway between the highest and lowest rates of these selected countries. Table 2 shows the infant mortality rates for select Canadian cities in 1890. Ottawa's infant mortality rate is higher than that of most Canadian cities. It is important to note that Quebec and Montreal, the two predominantly French cities shown here, have by far the highest rates of infant death; this pattern is reflected in this thesis' findings with respect to the ethnicity, language and religion of families in Ottawa who experienced the death of an infant. Ottawa, and indeed the rest of Canada, can be located at this time within the era of receding pandemics, as defined by the Epidemiological Transition Model.

Ottawa at the turn of the century was a city driven primarily by two industries; lumbering and government. These two industries had stimulated the city's growth and development during the nineteenth century and by 1901 the city's population stood at 57 640 (Census of Canada, 1901, Vol I, 3). The city was settled principally by

Table 2 - Infant Mortality Rates for Select Canadian Cities - 1890

City	Infant Mortality Rate (Deaths per 1000 live births)
Halifax	180
Quebec City	275
Montreal	285
Ottawa	185
Kingston	165
Toronto	200
Hamilton	155
Winnipeg	145
Vancouver	120

(Source: McInnis, 1990a, Plate 29)

English and French Canadians and this ethnic duality influenced the social and spatial patterns of settlement that developed. Essentially, by 1901 Ottawa was a city divided geographically along ethnic, linguistic, religious and economic lines. It is this pattern of spatial differentiation, so characteristic of Ottawa at the turn of the century, that provides the context for the work undertaken here.

This thesis seeks to establish, first of all, whether the social, economic and housing conditions of the four distinct communities of Ottawa were clearly different from one another. If Lowertown, in particular, were home to the city's poorest living conditions, as reflected in specific social, economic and housing factors, was the area's rate of infant mortality commensurate with its environmental conditions? What relationships can be found between specific social, economic and housing factors and the rates and patterns of infant death? Can the well-documented association between

infant death and living conditions be established for Lowertown in 1901? It is important to note, however, that the focus here is on correlation between these factors, rather than causation. It was these questions, then, that guided the work undertaken in this thesis.

As will be shown, the data gathered clearly demonstrate that the infant mortality rate in Lowertown was indeed significantly higher than in the rest of Ottawa and that the causes and seasonality of death were related, for the most part, to the environmental conditions that existed in this particular area at this time. This thesis argues, then, that specific social, economic and housing factors were related to the incidence of infant mortality in Lowertown in 1901 and that the causes, seasonality and locations of the infant deaths all help to support the argument that a relationship existed between poor living conditions and high rates of infant mortality. Chapters Two through Five are used to answer the above-mentioned questions in order to allow some conclusions to be drawn about the nature of infant mortality and urban living in "turn of the century" Ottawa.

Chapter Two of this thesis discusses the growth of the 'modern' city through an examination of the processes of industrialization and urbanization that transformed European and North American countries from primarily rural and agricultural to urban and industrial ones. Improvements in agricultural productivity in Europe freed traditional farm labourers to seek employment and opportunities in the rapidly growing cities of Europe and in the newly settled areas of North America. Technological improvements meant that fewer workers were employed on farms and as more people

moved to the cities to seek employment in the industrial sectors of the economy, the conditions in those cities became progressively worse, particularly for the poor.

Developments in intra-urban transportation networks allowed for the establishment of suburbs which eventually encouraged the residential spatial differentiation of urban residents based on ethnicity, race, and socio-economic standing.

Chapter Two also addresses the conditions of the city and, particularly, those factors that are associated with the higher incidence of infant mortality that occurred in specific locations in the city. An overview of the research into infant mortality in cities suggests that three areas are particularly important. Sanitation and public health, living standards, and fertility are the three categories of research that have received the most attention to date. Chapter Two concludes with an examination of three detailed studies that explore the incidence of infant mortality and its relationship with the social, economic and housing conditions of the city; these three studies are the most similar to the work undertaken in this thesis.

Chapter Three endeavours to put the state of 'turn of the century' Ottawa into an historical context. The development of the Capital from a military and transportation outpost through to a resource extraction centre and finally to a government city is outlined in this chapter. In conjunction with an overview of the political and economic development of Ottawa during the nineteenth century, this chapter also focuses on the processes that created the divided city that existed in 1901. Land acquisition policies and ethnic, religious and linguistic settlement patterns meant that Ottawa began and ended the nineteenth century with two distinct regions,

Uppertown and Lowertown. Through a detailed examination of primary sources, Chapter Three describes these divergent communities focusing mainly on the differences in ethnicity, language, religion, population density and housing type that existed between Lowertown and the rest of Ottawa. This chapter clearly shows that the social environment of Lowertown, as measured by these and other social, economic and housing factors, was poorer than the rest of the city.

Having shown that Lowertown was a dramatically different and 'worse-off' community than the rest of the city in terms of its social environment, Chapter Four endeavours to show that infant mortality was also more pronounced in this community. From a city-wide perspective, this chapter shows a strong pattern of clustering of infant deaths in Lowertown. An analysis of the seasonality of disease and of the most common causes of death shows that the diseases that most affected the infants of Ottawa were most often influenced by the poor environmental conditions that existed in Lowertown. Chapter Four also provides a description of the methodology used in this thesis; it explains the methods of data collection and statistical analysis used to draw the conclusions presented in this project.

Chapter Five outlines the social, economic and housing factors that are most associated with infant deaths in Lowertown alone. First, an examination of the location of infant death at various scales shows that only a marginal overall spatial clustering of infant deaths existed within Lowertown itself. However, a few blocks and block-faces within Lowertown experienced higher numbers of infant deaths than others. Social factors such as ethnicity, religion, language and literacy show that

French, Catholic, and French-speaking families were more likely to have a child die than were families of any other groups. An examination of housing quality reveals that wooden houses with high population crowding were again more likely to have infant deaths than other house types and less crowded households. Finally, study of the economic factors associated with infant mortality reveals that the assessed value of property is clearly linked to the incidence of infant mortality.

The final chapter summarizes the important components of each of the previous chapters and then outlines the general conclusions of this thesis. In this final chapter suggestions for future research are also provided.

Notes - Chapter One

1. This point has been made numerous times in the mortality, and particularly infant mortality literature. For more information see (among others): Beaver, 1973; Bradbury, 1990a; Condran and Cheney, 1982; Copp, 1974; Dyhouse, 1978; Gagan, 1989; Haines, 1995; McInnis, 1990a; Mooney, 1994; Morel, 1991; Ogden, 1994; Preston and Haines, 1991; Schofield and Reher, 1991; Smith and Frost, 1994; Thornton and Olson, 1991; Watterson, 1986; Woods, Watterson and Woodward, 1989; Woods, Watterson and Woodward, 1988.

2. Although this reflects an earlier date than that used in this thesis, it allows for a general comparison using data that was systematically gathered. In other words, each of the locations has a recorded infant mortality rate, measured by the same method, and for the same period. Although not ideal, this provides a context both for Canada's and Ottawa's infant mortality rates (Table 2).

Chapter Two:

Urbanization, Industrialization and the Living Conditions of a Nineteenth Century City

Introduction:

It is important to place this thesis, which focuses on the urban social environment of a turn of the century industrialized city, into the context of the urban and industrial growth of late nineteenth century cities in the industrialized world. However, in order to do this, this late nineteenth century growth must itself be placed in context. The first section of this chapter will do just that. Following this brief exploration into the causes and results of the processes of urbanization and industrialization is an examination of the living conditions of a number of these cities. Work that addresses the role of class relations in nineteenth century cities and the impact that 'class' has on living and working conditions will also be discussed. Studies on infant mortality rates of cities in industrialized countries published by prominent social historians, historical geographers, and demographers among others provide a context for the present study. Through a brief exploration of the factors that are believed to determine the rates of infant mortality in these cities, a framework within which to examine these same mortality rates for Ottawa in 1901 will be developed. The chapter concludes with an examination of the work on three specific cities that closely resemble the work undertaken in this thesis. Recent published works on infant mortality rates and the social and economic living standards of

Adelaide, Hamilton and Montreal provide insights that will inform this discussion. The final section of this chapter identifies the social, economic and political factors essential to understanding the present study of Ottawa.

Urban and Industrial Growth:

As early as the end of the seventeenth century, the European, and particularly English, economies began to undergo the first important changes, mainly within the agricultural sector, that eventually gave rise to the Industrial Revolution (Hohenberg and Lees, 1985, 135 and 177-178). Due to technological innovations in the burgeoning industrial economy of the eighteenth century, European agricultural productivity doubled. This increased productivity, which was unmatched by population growth, allowed many workers to be freed to work in non-agricultural sectors of the economy. In fact, England's economy, which largely initiated this productivity improvement, soon had more non-agricultural labourers than ever before. A country with some seven million people around 1780 had thirty per cent of its working population employed in sectors other than farming and still only imported approximately five per cent of its food (Bairoch, 1988, 211). By 1800, England's food imports had declined further, and its labour force was moving further away from agriculture, to a point where sixty per cent were non-agricultural workers. All of this was reflected in a tremendous growth of the urban population of England, as urban areas became the source of almost all non-agricultural employment. In 1700, most of

England's population lived on farms or in small rural towns, but by 1800 approximately 23 per cent of England's population was living in towns greater than five thousand people, and by 1850 almost half of the population lived in these towns (Bairoch, 1988, 211).

While the Industrial Revolution was confined almost exclusively to England during the first seventy to eighty years of the eighteenth century, it began to spread outwards towards the end of the century. Between 1760 and 1785 countries such as France and the United States began to industrialize and underwent the process of rapid urbanization (Bairoch, 1988, 211). Much of the rest of Europe, North America, and Australasia would industrialize during the nineteenth century. Not only did these developments change economic systems from agricultural to industrial, but they also changed the nature of society from one in which much of the population lived in rural settings to one where the population was becoming more urban and centralized.

Europe in the nineteenth century was witness to unprecedented growth. Around 1840, England's population was forty per cent urbanized and it was nearly seventy per cent urbanized by 1880 (Bairoch, 1988, 216). The rest of Europe lagged behind England, but nonetheless became more urbanized too. By 1800, continental Europe was twelve per cent urbanized, and this grew to twenty per cent by 1850 and almost forty per cent by 1900 (Bairoch, 1988, 217). Between 1800 and 1910, the European urban population increased from 19 million to over 125 million mainly due to two factors, rural to urban migration and overall population growth (Bairoch, 1988, 216-217). To these two factors, Mumford adds that the benefits of economies of scale

which led to production agglomeration in particular locations also contributed to the increasingly urbanized nature of the European population (Mumford, 1961, 455).

Although mass migration to the cities from the rural countryside was characteristic of the nineteenth century, so was overall population growth. While the eighteenth century saw the total European population grow by only fifty million people from one hundred million in 1700, the nineteenth century's European population grew by almost 140 million between 1800 and 1900 (Bairoch, 1988, 217). With the population of Europe growing rapidly during the nineteenth century and the process of industrialization forcing more people from their farms to the factories of the cities, it is not surprising that it was during this century that the modern metropolis was formed. It is important to note, however, that off-setting these two processes of urban growth in Europe was the overall negative effect of massive, primarily rural, emigration to North America and elsewhere.

As the timing of the European Industrial Revolution was tied to the economy of England, so was the timing of the American, and subsequent Canadian, Industrial Revolutions. The characteristics of the first waves of immigrants to Canada and the United States, in the seventeenth and eighteenth centuries, led to a fundamentally rural society. This was achieved through the active recruitment, by immigration officials, of those Europeans thought to have strong agricultural backgrounds (Harris and Warkentin, 1991, 117). As a result, the two largest cities in North America in 1700 were Boston and Quebec with only between six and seven thousand people each (Bairoch, 1988, 222). Throughout the eighteenth century some North American cities,

mostly in the United States, experienced rapid urban growth so that by 1800 Philadelphia had almost 70 000 people, New York 65 000, Boston 35 000, and Montreal 15 000 (Bairoch, 1988, 222; Marshall, 1989, 44). Despite this apparent urbanization of North America, the continent was still predominantly rural at the beginning of the nineteenth century, in the order of approximately 95 per cent rural as compared to 85 per cent in continental Europe and only 75 per cent in England (Bairoch, 1988, 222).

This low level of North American urbanization can be explained through social factors such as the recruitment, by North American immigration officials, of the most vulnerable and repressed populations of Europe, who often were of rural backgrounds. In addition to this, geographic and economic factors contributed to the lack of urbanization in North America. The newly colonizing society used metropolitan centres as attachment points for commercial activity, but was still predominantly agricultural and therefore low density. Thus, the essential rural-ness of early North America was not conducive to the emergence of cities. In conjunction with the rural nature of the early North American society, the colonial economic policies of England which were in place through much of the eighteenth century in the United States and Canada limited both Canadian and American industrial growth (Bairoch, 1988, 222; Conzen, 1987, 347-348; Harris and Warkentin, 1991, 192-193 and 210-219). British requirements that resources be shipped to England for secondary processing is a classic example of this policy. The processing of resources into manufactured goods was the initial catalyst for the Industrial Revolution in Europe and so these restrictive

eighteenth century British colonial policies therefore, limited the industrial growth of North America. America's independence from Britain had a significant impact on its industrialization process as the new country could produce goods, from its own resources and ship them abroad for profit, and thus continue to develop its own industrial sector.

As North American immigration during the seventeenth and eighteenth centuries contributed to a primarily rural society, the massive scale of immigration during the nineteenth century, to both Canada and the United States, played a significant role in the development of industrial urban centres. Like at home in Europe, many of these new immigrants perceived more opportunities for economic prosperity in the North American cities (Ward, 1971, 75-81). As a result, the United States experienced rapid economic and industrial growth during the nineteenth century, at a rate that actually exceeded Europe's (Bairoch, 1988, 222). Canada's industrial growth spurt did not occur until later in the nineteenth century, mostly spurred on by the influx of European immigrants after 1850, but nonetheless much of this growth was the result of immigrant populations settling in the cities.

As a result of all of this, by the start of the twentieth century, England was still the most heavily urbanized country in the world, followed closely by the United States and then by some of the countries of continental Europe. While the nineteenth century was a century that saw most countries of the western world industrialize, the United States' economy probably changed more than that of any other country. One of the reasons for the highly industrialized and urbanized state of America's economy was

the high agricultural productivity that it enjoyed (Conzen, 1987, 348). By being able to feed its population with as little human input as possible, the American industrial machine was better equipped to produce goods for the growing world markets. As a result, by 1900, of the eleven largest cities in the world, all with populations over one million people, the United States had three; New York, Chicago, and Philadelphia (Bairoch, 1988, 223).

Increased agricultural efficiencies in the eighteenth and nineteenth centuries meant that fewer hands were needed in agriculture and freed for other types of employment (Bairoch, 1988, 287). Much of this new employment was found either in the extraction of natural resources, such as coal and other minerals used in the growing industrial economy, or in the cities where these new industries themselves were located. Throughout the nineteenth century, population grew, agricultural productivity continued to increase, and the industrial sector of the economy became more entrenched. All of these factors, combined with the high rates of population mobility, both from the countryside to the cities and from one country or continent to another, led to a dramatically different pattern of distribution of people at the end of the nineteenth century. Hundreds of millions more people living together in cities did not come without problems and it is to some of these problems of urban living that this thesis now turns.

In mid-nineteenth century American cities, the landscape was comparatively heterogeneous with people of greatly different income and social status living side by side (Conzen, 1987, 364). Many neighbourhoods, like those discussed by Warner in

Philadelphia and Boston, that were usually located close to the central business district, were mixed with families from many different classes, ethnicities and occupations (Warner, 1987, 50; Warner, 1978, 15). Several key developments changed this situation during the latter part of the nineteenth century. Commercial congestion in the central core from the growth of the commercial sector of the economy, the construction of more spacious and expensive homes on the fringe of the cities, the appearance of public transportation on the cities' major streets, and most importantly, the extreme pressure on the existing housing stock by the accelerating rates of immigration and rural to urban migration, all contributed to a changing urban residential landscape (Conzen, 1987, 364; Warner, 1987, 50; Warner, 1978, 21-28). The result was an often concentric pattern of residential settlement with the immigrant and working-classes forming a tight wedge between the central business district in the core of the city and the wealthier upper- and middle-classes living on the city's fringe (Conzen, 1987, 364).

Unprecedented commercial and industrial growth was also matched by new housing construction in large cities, which increasingly encouraged people to change residences. The well-off upper-class moving into the newest houses on the urban fringe, the middle-classes taking over the vacated homes of the wealthy, and the immigrant and working-classes being left to take over those houses of the vacated middle-class (Conzen, 1987, 364). However, the growth of the commercial centre of the city was often so great that the working-class was faced with increasingly less available housing and space, while their population grew at a greater rate (Conzen,

1987, 366).

Several Canadian examples of this pattern of residential segregation exist. Goheen found that in Toronto in the latter half of the nineteenth century, economic rank or class served a more significant role in the process of residential segregation than did social factors like religion (Goheen, 1970, 194). He found that families of unskilled, skilled, clerical and professional employees were residentially separated from each other. Goheen's conclusions confirm the patterns seen in cities of the United States such as Philadelphia and Boston (Warner, 1987, 169-176; Warner, 1978, 53-66). However, Hiebert, studying Toronto at a somewhat later date, 1931, found that residential segregation was not simply a result of economic class, but also of ethnicity (Hiebert, 1995, 70). Hiebert uncovered this dual process of residential segregation for twentieth century Toronto, but Goheen could not identify this same process for nineteenth century Toronto (Goheen, 1970, 194; Hiebert, 1995, 55). It is not clear whether this dual process of residential segregation in Toronto was a development of the twentieth century or had been in place, but not as clearly identifiable, since the nineteenth century.

In describing Hamilton in the 1890s, Wood found that the process of socio-economic segregation was extreme.

While many families lived in comfort and some in luxury, the working-classes experienced great hardship. Most people in this category lived in small rented cottages, poorly constructed and lacking in amenities. (Wood, 1987, 121)

Gagan also found Hamilton to be residentially segregated with economic class and occupation as the differentiating factors; the newly arriving working-class immigrant

populations, regardless of ethnicity, joining the working-class in the wards of the north end of the city (Gagan 1989, 162 & 169). Moreover, in their recent examination of early twentieth century owner-built suburbs of Hamilton's east end, Harris and Sendbuehler describe a process of segregation similar to that discussed by Wood and Gagan.

There seems to have been a social gradient away from the lake, with owner-building by unskilled workers most common in areas like Union Park that were fairly close to lake front industry. More substantial brick homes were built by contractors for skilled manual and white-collar workers farther south toward the escarpment. (Harris and Sendbuehler, 1994, 506)

Similar patterns of residential separation of the economic and social classes of the late nineteenth century have been found by others for these and other Canadian cities such as Kingston, Hamilton and Montreal (Harris, Levine and Osborne, 1981; Osborne, 1975; Davey and Doucet, 1975; Katz, 1975; Olson and Hanna, 1990; Thornton and Olson, 1991).

The residential socio-economic differentials described above, denoted by either occupation, income, ethnicity, or race, continued to grow throughout the nineteenth century as those most able to own property benefitted from industrialization and business growth and thus gained more wealth and more control. These property owners were then able to seclude themselves from the 'urban masses' and the congestion of the city both through larger, private properties and through distance. More and more, the wealthy removed themselves from the heart and core of the city, where they had benefitted from being close to the business activities of the early and mid-nineteenth century city, to the secluded precincts of the suburbs (Ward, 1971,

125; Warner, 1978, 35). Although few in number but financially powerful, this class increasingly redefined the urban landscape by creating expensive residential sectors often in the most desirable suburban locations such as on lake shores and scenic hillsides. A classic example of this is Lindenlea, a 'garden suburb' of Ottawa built in the post-World War One period (Delaney, 1991, 151). The design of the houses and the overall plan of the suburb reflected the contemporary premises of the Canadian urban reform movement of the time in which the urban environment, taken to mean the public and moral health of the community, was turned into a benefit of urban living (Delaney, 1991, 151-152).

The much larger middle-class attempted a similar strategy and found that the social mobility made possible in the late nineteenth century was best expressed through residential mobility (Conzen, 1987, 364). An interesting example of this social and residential mobility is provided by Katz in his examination of various 'ordinary' people of nineteenth century Ontario. One particular example is of a young working-class emigrant Irishman from Belfast who arrived in Canada in 1841 and moved his family eight times and changed occupations twenty-three times during his thirty years in Canada (Katz, 1975, 94-111). As he changed occupations frequently, his place on the social ladder also changed and he slowly moved upwards from his beginnings as a general labourer and eventually to a farmer and storekeeper, all the while moving his place of residence to take advantage of better opportunities (Katz, 1975, 110). Moving more often, and with less exclusivity than the wealthy, the middle-class, of which Katz's Irishman became a member, eventually moved into established genteel

residential neighbourhoods. Most importantly, this middle class pattern was responsible for the majority of the physical growth of the size of the city through the construction of new residential suburbs (Mumford, 1961, 483; Warner, 1978, 9).

Unlike the wealthy- and middle-classes who were able to own their homes, the poorer classes, made up largely of immigrants and rural migrants, were limited by low incomes to renting homes in slum, or at best, near-slum conditions. Many commercial and industrial buildings and vacated middle- and upper-class houses were converted for higher density occupation (Copp, 1974, 73). Instead of living on hillsides, or beside beautiful lakes, or even in sprawling suburban neighbourhoods, the members of the working-class were forced to live near their places of work. This meant that they lived in less desirable locations such as floodplains, poorly drained plains, and even awkward parcels of land between industrial plants and railroad yards (Conzen, 1987, 366). In his work on Toronto, Goheen confirms this pattern, finding that the poor and unskilled workers were not able to compete with the wealthier classes for the most desirable residential locations and so were forced to live in the least appealing areas, often close to industrial and commercial cores of the city (Goheen, 1970, 128).

This practice of workers living near their place of business had been, in fact, the norm up until the mid-nineteenth century for all classes and occupations; it is clear that mill owners, craftsmen and professionals almost always lived near their places of work. As the central core of cities became more industrialized and more crowded, and as streetcar transportation was developed, the members of the more socially mobile population were able to separate their places of work from their residences

while those of the working-class were not. In older cities, which were often limited in space, many working-class neighbourhoods were either replaced by commercial or industrial buildings, or became even more densely populated as one and two storey homes were torn down and replaced with five and six storey rooming houses or tenements. Often these neighbourhoods deteriorated into slums through over-population and financial disinvestment.

For many large North American cities, social stratification was primarily defined by income and class, while other cities were divided into communities defined by ethnic origin. Immigrants who settled in cities often formed ethnic ghettos which can be defined as districts that were overwhelmingly inhabited by people of one or two related origins (Hiebert, 1995, 67; Ward, 1971, 55). Common ancestral origins and economic predicaments held these immigrants together in these usually dense urban neighbourhoods. In some cities, like Toronto, New York, Boston, and to a different degree Montreal, this process of ghettoization, was the primary component of residential segregation (Conzen, 1987, 366). In other words, the social landscape of the city was often defined by the clustering of specific ethnic origins into compact regions. On the other hand, in the more heavily industrialized cities like Milwaukee, Hamilton, Detroit, Cleveland, and Pittsburgh, income and economic classes were more important in influencing residential segregation than was the process of ethnic ghettoization (Conzen, 1987, 366).

No doubt, the wealthy-class that ended up owning much of the residential housing of the very poor felt that it was more profitable to house them in crowded

inner city buildings and tenements than in newly constructed and well maintained homes (Ward, 1971, 106-117). Perhaps, they also felt, as landlords and taxpayers, that they would see little economic benefit in providing adequate sanitary services to either the residences or the neighbourhoods. As a result, large tracts of the inner city had unpaved and uncleaned streets, inadequate or non-existent sewage and refuse removal, contaminated water and food sources, and politically, a largely powerless resident population (Conzen, 1987, 367). Overcrowding in districts with primitive household and street sanitation naturally encouraged epidemic outbreaks of disease that eventually spread out of the working-class districts to the homes of the middle- and wealthy-classes. Often it was this process, along with the work of philanthropists and social reformers, that eventually led to reforms in the supply of fresh water and public health services. In these latter decades of the nineteenth century everything from housing, sewers, water supply, refuse removal, pollution, and even crime, politics and morals were "cleaned up" (Valverde, 1991). In fact, contemporary reformers were even convinced that the appalling state of the inner urban environment, and in particular the decrepid and overcrowded housing, was the source of social deviance. They believed that by cleaning up this urban environment the problems of poverty, criminal and immoral behaviour could also be eliminated (Valverde, 1991, 130).

Clearly the living conditions of the working-class of Europe and North America in this period of rapid industrial growth were much worse than for the rest of the population. The work of German Socialist theorist Friedrich Engels on the living and working conditions of the English, and specifically Manchester working-class, is a

classic in this regard. In the 1840s, Engels wrote about the working-class within the context of the capitalist Industrial Revolution. Engels described, as he viewed it, the oppressive relationship between the capitalist middle- and upper-classes, and the industrial working-class (Engels, 1958). He predicted that the proletariat would eventually rise up against the bourgeoisie because of the abysmal working and living conditions forced on them by capitalist interests (Engels, 1958, 338). Engels also described the working and living conditions of the poor, and made connections between their standard of living and their health. He writes,

[t]he filth and the stagnant pools in the working-class quarters of the great cities have the most deleterious effects upon the health of the inhabitants because they engender just those gases which give rise to disease. The same effect follows from the miasma exuded by foul streams. But that is not the whole story by any means. The way in which the vast mass of the poor are treated by modern society is truly scandalous. They are herded into great cities where they breathe a fouler air than in the countryside which they have left. They are housed in the worst ventilated districts of the towns; they are deprived of all means of keeping clean. They are deprived of water because this is only brought to their houses if someone is prepared to defray the cost of laying the pipes. River water is so dirty as to be useless for cleansing purposes. The poor are forced to throw into the streets all their sweepings, garbage, dirty water, and frequently even disgusting filth and excrement. The poor are deprived of all proper means of refuse disposal and so they are forced to pollute the very districts they inhabit. And this is by no means all. There is no end to the sufferings which are heaped on the heads of the poor. It is notorious that general overcrowding is a characteristic of the great towns, but in the working-class quarters people are packed together in an exceptionally small area. (Engels, 1958, 110).

Engels goes on, at some length, showing how each of these deleterious living conditions is connected to diseases such as consumption, scarlet fever, typhus and childhood mortality (Engels, 1958, 111-118). Although Engels' writing does not

necessarily reflect the dominant attitudes of the time, it is clear that the adverse conditions of urban, particularly English working-class living associated with the industrial era of the latter half of the eighteenth and throughout the nineteenth centuries were being recognized by some articulate opponents and commentators.

By the mid-nineteenth century, the Industrial Revolution in England had already established a clear division between the working-class and the middle- and upper-classes; in Canada, however, the industrialization of the economy was only beginning (Kealey, 1980, xiv). At the same time that Engels was writing about the adverse effects that industrialization had on the English working-class, the process of the industrialization of the Canadian economy was just underway (Kealey, 1980, 3). Kealey, through a detailed examination of the rapidly industrializing economy of Canada, and particularly Toronto, through the period of 1850 to 1890, shows that the living conditions of the working poor, although better than those of the poor in England, were abysmal. It is interesting to note that it was these living, and more importantly, working conditions of Toronto's industrial working-class, along with technological change in the workplace that stimulated the formation of strong trade unions by the end of the nineteenth century (Kealey, 1980, 291-292). It was the mandate of these trade unions to force employers to pay a decent wage and provide safe and adequate working conditions for their employees.

In another example, in his examination of a late nineteenth century industrializing Canadian city, Doucet demonstrates that in Hamilton the process of industrialization further segregated the working-class from the wealthy (Doucet, 1976,

101). A relatively small city compared to Kealey's Toronto or Engels' great towns of England, Hamilton was often described by travellers as a beautiful town. Despite these often kind words, Doucet contends that as early as the 1850s, Hamilton had its own share of housing and sanitation problems (Doucet, 1976, 85). The worst conditions often were associated with the working-class, and when issues of industrial pollution arose, the interests of business and civic progress almost always took precedence over those of individuals most affected, particularly the poor (Doucet, 1976, 85). Industrialization had a profound effect on Hamilton in the nineteenth century as the city grew in size and stature within the Canadian economic landscape (Doucet, 1976, 83). Despite this overall economic growth, Hamilton's working-class became ever more isolated from the wealthy-classes. Similar to the patterns discovered by Goheen for Toronto, the working-class increasingly were forced to live near the industries, railways, and even poorly drained marshes at the north-end of Hamilton, while the wealthy concentrated in the south on the well drained, gently rising slopes at the foot of the Niagara escarpment (Doucet, 1976, 101; Goheen, 1970, 128). Clearly, Hamilton, despite its moderate size was affected by the same processes of residential segregation, and suffered the same degradation of working and living conditions as many other industrializing cities of the nineteenth century such as Toronto, London, Manchester, Montreal, Boston and Philadelphia (Goheen, 1970; Hiebert, 1995; Engels, 1958; Thornton and Olson, 1991; Warner, 1978; Warner, 1987).

The urban environmental conditions of these and other late nineteenth and early

twentieth century cities are one key element of this thesis. Understanding the way people lived, as influenced by their 'class', income level, education, occupation, ethnic origin, linguistic background, and political power as reflected through the availability of essential sanitary services provided to them by the city, is critical to the reconstruction of the urban social environment. How each of these factors of living affected the way people lived is not always clear, but their relationships to infant mortality rates allow for the study of some of these effects. Much work has been published on the incidence of infant mortality in the industrialized cities of Europe and North America, and the link between the infant mortality and the factors of living is central to this work. Several themes, or types of factors, have emerged from the literature as important in the cause of infant mortality. It is to these themes of infant mortality research that this thesis now turns.

Themes of Infant Mortality Research:

Of the many studies that have been undertaken by demographers, social historians, historical geographers, and others, in the broad field of mortality in the late nineteenth and early twentieth century urban areas, most have incorporated a temporal element, in which the authors attempt to measure the change in mortality rates over time. Moreover, within these studies of the mortality of the general population, much attention has been directed to the problems of infant mortality in particular. Although the present work does not incorporate a temporal component, many of the conclusions

drawn from the literature prove relevant to this thesis. For example, considerable attention has been paid to the declining rates of general mortality in Europe and North America since the mid 1800's, and of infant mortality since the end of the 1800's, in these urban centres. Many of the factors that have been considered key in the decline of these general and infant mortality rates can also be considered as specific 'causes' of urban mortality. Thus, it is important here that these key factors be explored and interpreted in the context of Ottawa.

Sanitation and Public Health

Three broad themes or groups of factors can be drawn from the literature. The first theme covers quite a broad spectrum of specific causes and can be labelled as "Sanitation and Public Health". Within this group, several more specific problems have been identified, such as; inadequate, contaminated, and unfiltered water supplies; a lack of sewage and refuse removal from all districts of the city; the unregulated and uninspected supply and distribution of food and, more importantly, milk for infants; the lack of proper nutrition for children, infants and parents alike; the non-existence of formal systems for educating parents on proper child care in urban settings; a lack of a cohesive and effective 'public health' system in which residents are inoculated and vaccinated against specific diseases; and finally, the role of climate in exacerbating some of these sanitary problems. It becomes quite clear that the lack of these services and essentials for urban living could have contributed to the high rates of infant

mortality of the late nineteenth century. Many of these important 'causes' of infant mortality will be revisited in later chapters of this thesis when the specific cases of Ottawa and Lowertown are examined. However, some of these key factors have received particular attention. They relate directly to this present study and so warrant further discussion.

By the late nineteenth century, public health officials recognized that typhoid fever epidemics and other diarrhoeal diseases resulting from water-borne pathogens were linked to the provision of sewers and waterworks (Condran & Cheney, 1982, 119; Condran & Crimmins-Gardner, 1978, 33-34). Condran and Cheney (1982, 111), in their study of mortality trends in Philadelphia, found that the extension of the water supply system did little to improve the health of the city and in some cases helped to spread typhoid and other contagious diarrhoeal diseases to new districts of the city. What they did find to be significant was that the construction of water filtration systems and the provision of pure and filtered water to the residents of Philadelphia had a positive effect on the reduction of outbreaks of typhoid, as it did in other American cities at this time (Condran & Cheney, 1982, 111-112; Crimmins & Condran, 1983, 42; Higgs & Booth, 1979, 365). It is apparent from this study of Philadelphia that the provision of filtered water had more of an immediate impact on the decline in adult mortality than on infant mortality, but it is also clear that this public health initiative did have a greater impact on declining infant mortality rates in the early twentieth century.

Even more important to infant survival was the supply of fresh and wholesome

milk. Much of the research on this topic has focussed on two distinct but related issues: first, the importance of breast feeding because of the provision of maternal antibodies that help the infants fight off infection and secondly, research has focussed on the importance of providing a clean and safe alternative to breast feeding through the provision of healthy 'artificial' milk (Beaver, 1973; Copp, 1974; Dyhouse, 1978; Mooney, 1994; Thornton and Olson, 1990). Breast feeding provides the essential nutrients that lead to the healthy growth and development of babies, provides antibodies that help fight off infection and disease, and limits the child's exposure to environmental pathogens in 'artificial' milk and water. Contemporary public health officials had established the link between contaminated milk supplies and infant mortality and so, efforts were undertaken, first of all to encourage mothers to breast feed, and secondly to improve the quality of the artificial milk supply (Dyhouse, 1978, 249-250). For example, in 1874 the Obstetrical Society of Philadelphia distributed forty thousand pamphlets urging mothers to breast feed, to postpone weaning until after the more dangerous summer months had passed and to use clean nursing bottles for children who were not being breast fed (Condran & Cheney, 1982, 114).

While public health officials spent considerable effort encouraging mothers to breast feed, their most important task in this regard was ensuring that families had access to clean, safe and healthy liquid and powdered 'artificial' milk supplies. Beaver (1973, 29) has argued that the decline in infant mortality in England in the twentieth century was largely the result of the growing availability of pathogen-free milk. However, the problem of milk supply was certainly not limited to England and,

as Copp has pointed out, it was a particular problem in Montreal (Copp, 1974, 97). For example, a 1914 Federal Department of Agriculture bacteriological study of the Montreal milk supply found that at the point of production thirty per cent of the milk was classed as grade "C", which on the North American milk grading scale was deemed unfit for human consumption unless used in the manufacturing of other food (Copp, 1974, 97). Worse than this, however, was that the inspectors were forced to create a new category of milk, labelled "D", which they estimated to be five times worse than grade "C" milk. This accounted for twenty per cent of the milk at the point of production (Copp, 1974, 97). Moreover, due to the mixing of different grades of milk during distribution, ninety per cent of the milk was unfit for human consumption by American standards, by the time it reached outlets in Montreal (Copp, 1974, 97).

From this, it is clear that the milk supply was often contaminated at the source, but in addition, the dilution of milk with polluted water, by distributors and parents to make expensive supplies last longer, also contributed to the problem. In addition to this, the nutritional quality of the artificial milk provided to the baby, even if uncontaminated, was often inadequate to allow them to fight off disease and grow healthily. As Beaver (1973, 43), Copp (1974, 96), Condran & Cheney (1982, 114-115) and Dyhouse (1978, 251) all point out, one of the most significant factors affecting the decline in infant mortality rates in both Europe and North America was the provision of a safe and healthy milk supply through pasteurization and dried milk.

Many of the factors or causes of infant mortality that have been identified

within the literature and that have been grouped here can be affected or exacerbated by climate. Inadequate sanitation, poor nutrition and ineffective public health and medical practices become more pronounced in regions and seasons with hot and dry weather. In the literature, many of these sanitary and public health factors have been identified as being climate related, often resulting in the seasonality of disease and infant death. As seen in almost all of the factors within this category, the youngest age cohort, those under one year of age, are the most susceptible to seasonal variations in weather and therefore environmental conditions. Mooney (1994, 158) shows that in 1899 over forty per cent of all of London's infant deaths occurred during the summer months, defined as July through September, most of which were the result of diarrhoeal and other water-borne illnesses. Similarly by 1915, many of the poorer areas of London were still being heavily hit by the 'season of death' (Mooney, 1994, 158). In all areas of London, the summer season was the worst for infant deaths largely because the bacteria that caused diarrhoeal diseases such as cholera, typhus, and 'debility' were carried by the flies that flourished in the hot summer months (Mooney, 1994, 165).

During years with hot and dry summers the incidence of diarrhoeal and dysentery outbreaks increased as did the mortality rates of infants since less water was available and it was more likely to be contaminated (Mooney, 1994, 166-167). Also, sewage and refuse became more contaminated during this hot and dry weather (Mooney, 1994, 167; Woods, Watterson & Woodward, 1988, 360). Therefore, climatic conditions, particularly during the summer months most likely interacted with

the poor urban sanitary conditions and resulted in higher levels of diarrhoea, typhoid, and dysentery among infants (Woods, Watterson, & Woodward, 1988, 360). The consistency of this higher summer mortality was recognized by contemporary public health officials and programs to alleviate the problem were introduced.

Living Standards

Another group of factors that can be linked to the changing rates of infant mortality at this time can be labelled "Living Standards". Again this category encompasses many important characteristics of urban life including; high density living both within the home and the surrounding neighbourhood; poorly constructed, heated, and ventilated homes; relatively low family incomes where often many young children had to work rather than attend school; parents working in industrial and manual occupations where the on-the-job hazards were great as were the risks to being exposed to hazardous pollutants. This group of factors tells us something about the social and economic class of the families most susceptible to illness, as well as the direct environmental conditions that the infants and their mothers were exposed to on a daily basis. It is not surprising that the home environment and the socio-economic class of the families had a direct influence on the health of the most vulnerable of the family and society.

One of the difficulties encountered in a study of this type is distinguishing which variables are having which effect on infant mortality. When it comes to socio-

economic or living standard variables this problem is quite pronounced. For example, some authors have tried to establish links between income and infant mortality, but the results are often not conclusive (Dyhouse, 1978; Haines, 1995; Higgs, 1979; Thornton and Olson, 1994; Watterson, 1988; Woods, Watterson and Woodward, 1988).

Questions still remain as to which of income, occupation or social class is the most accurate and influential factor in the infant mortality debate. Also to complicate matters is the natural link between these socio-economic living standards and the resultant sanitary and environmental conditions discussed above. As income, occupation, and/or social class change, so do many other important variables such as; population density; access to healthy supplies of food, milk and water; the prompt and efficient removal of refuse and sanitary waste; and the availability of higher education and knowledge about nutrition, parenting, and health care.

It has been pointed out in the literature, to no surprise, that as positive changes are made to the standard of living of the population, the rates of infant mortality decline accordingly. In their examination of the declining rates of infant mortality in England and Wales between 1861 and 1921, Woods, Watterson and Woodward (1988, 365) were able to determine a negative relationship between income and infant mortality, as well as a similar relationship between social class and mortality. Lee's recent study which shows the regional differences in infant mortality in Britain between 1861 and 1971, also found that areas with higher concentrations of industrial employment had higher rates of infant mortality (Lee, 1991, 64-65). Lee also speculates that as Britain's economy relied less on industrial production throughout the

twentieth century, the rate of infant mortality declined accordingly (Lee, 1991, 62-63). The link that Lee makes is that since living standards, as seen through income, housing density and nutrition, have traditionally been worse for families with primary employment in heavy industry, as industrial employment overall has declined so has infant mortality.

As Watterson (1986, 297) has pointed out, the most dramatic changes to the urban environment over the past 100 years have come from improvements in sanitation, refuse and sewage removal and public health. It is apparent that these improvements could have had a significant impact on all urban residents regardless of income, but as she clearly shows, the impact was somewhat greater for those with higher incomes. She has also pointed out, however, that increased income alone would not have resulted in greater declines in the infant mortality rate, as shown by the example of specific occupations that received wage increases without corresponding changes in the infant mortality rate (Watterson, 1988, 298 and 302). Therefore, it becomes clear that while it is almost certain that factors such as income, occupation and social class all have an impact on the rates of infant mortality, it is not clear which are the most important. It is very difficult to isolate any of these factors from the others as well as from the sanitary and public health factors.

Fertility

Almost all of the factors leading to explanations of infant mortality that have

been raised in the several studies and projects over the years, several of which have been discussed here, can be placed into the two main categories described above; "Sanitation and Public Health"; and "Living Standards". However, one factor remains on its own, as it does not fit into either category, and so will be discussed briefly here. Although the broader category may include several trends or patterns usually described under the title of demography, the factor that really plays a role in the infant mortality debate is fertility. The decline in fertility in most of the industrialized world following the middle of the nineteenth century is well documented, but any link to the decline in the infant mortality rate in the late nineteenth and early twentieth centuries is to date tenuous.

Some authors have done work in this area, but little of a conclusive nature has been established (McInnis, 1990a; Thornton and Olson, 1991; Watterson, 1988; Woods, Watterson and Woodward, 1989). Watterson (1988, 292) believes that the decline in fertility would likely increase each individual child's share of food, water, child care and other commodities, but she was unable to conclusively find this link. Woods, Watterson and Woodward (1989, 121-126) also believe that the decline in fertility would provide more opportunities for the fewer infants. They also speculate that the arrival of fewer newborns would relieve pressures on the mother to care for them and thus increase the chances of survival of older children as they would receive more care from their parents (Woods, Watterson and Woodward, 1989, 122). Perhaps, other factors resulting from the decreased fertility such as increased relative size and quality of the dwelling, and better educational opportunities also may have

increased the survival rate of infants. Although the logic behind these theories of declining fertility and a resultant decline in infant mortality rates seems sound, the inability to conclusively prove the link remains problematic.

Adelaide, Hamilton and Montreal:

While many of the themes associated with infant mortality in turn of the century urban areas of the western world should be, and are, relevant to most studies of infant mortality, what is common among all of them is that they were based on studies that incorporated a temporal component. In other words, the authors tried to explain the decline in infant mortality over a specific time period through the use of one or more of the above mentioned variables. As this present study of Ottawa is cross sectional, rather than temporal, in nature, it seems pertinent to examine the work of scholars that have attempted similar cross sectional work. As will become apparent shortly, many of the factors found to be significant in these works are similar to those found through the temporal studies. Therefore, these three cross-sectional studies become excellent templates for this examination of turn of the century living conditions and standards in Ottawa.

In "Suburbia and Infant Death in late nineteenth and early twentieth century Adelaide" Smith and Frost explore the relationship between population density and public health. They argue that the need for suburban housing was central to considerable social and political debate in Adelaide, in Australia and elsewhere (Smith

and Frost, 1994, 252). At the beginning of the twentieth century, the problems associated with sanitation and water supply had been partially rectified and the overall health of the city had improved, but the essential relationship between population density and mortality, and particularly infant mortality, had not changed. Population density in Adelaide in the early 1880s varied from 100 persons per acre on some streets in the poorer neighbourhoods to only 12 per acre in the more affluent areas (Smith and Frost, 1994, 257). As in other cities, the high density, high mortality areas were easy to identify by their physical characteristics; over-populated, damp and poorly drained with few open areas to allow for ventilation in or around the dwellings (Smith and Frost, 1994, 257). On the other hand, the suburban low density neighbourhoods, like in other cities around the world, were identified most prominently by the abundance of open space, higher incomes associated with higher land values, and better access to infrastructure services and education.

In the 1880s, Adelaide's infant mortality rate was nearly 190 per thousand; by the 1890s, it was down to under 130 due to increased efforts at building sewers and providing fresh water to many, but not all, areas of the city (Smith and Frost, 1994, 258). By 1901, due to the efforts of the city in providing these better infrastructural services the rate was down to 108 and by 1911, the year of Smith and Frost's cross-sectional study it stood at only 77 per thousand (Smith and Frost, 1994, 259).

However, these numbers reflect the average for the city as a whole and do not show the differentials between neighbourhoods. Adelaide was similar in this respect to most of the urban centres in Britain, Europe and North America where certain districts had

significantly different infant mortality rates than others. Whereas Britain's poor and affluent communities had a differential of as high as 100 per cent in the late nineteenth century, Adelaide's was low in comparison, but still high at 48 per cent in 1900 (Smith and Frost, 1994, 258). Much of this differential was due to the poorer areas still being largely without sewers (Lee, 1991, 56-61; Mooney, 1994, 162; Smith and Frost, 1994, 258). However, Smith and Frost (1994, 260) argue that the lack of accessibility to sewers, garbage collection and fresh water for some residents alone may not explain the differential in infant mortality rates. Rather, they assert that the explanation, most likely, lies in the overall inherent differences associated with industrial working-class and middle-class residents.

In Adelaide, so-called 'black spot' streets existed where two or more infant deaths occurred in a year, the frequency producing an infant mortality rate of between 250 and 500 (Smith and Frost, 1994, 265). The essential characteristics of these 'black spot' streets were as expected; short, low lying, dead-end streets, with wood houses or buildings that had been densely built up for at least 30 years, and primarily occupied by highly mobile tenants with large families (Smith and Frost, 1994, 266). Two significant factors must be examined. First, these 'black spot' streets were no different than the neighbouring streets that had few or no infant deaths and second, from one period of study to the next, the location of the 'black spot' streets varied. Both of these characteristics suggest that it was not solely the physical environment that determined high mortality areas, but rather that the standard of living and conditions inside the homes themselves ultimately determined the infant mortality rate

(Smith and Frost, 1994, 270). These two final conclusions from the work of Smith and Frost are important for this present study of Ottawa. As in Adelaide, not only will the external physical environment of Ottawa and Lowertown such as; sewers, water, and housing structure be examined, but so will the 'internal' factors such as standard of living, household density and education.

While other cities in North America, during the first and second decades of the twentieth century, were beginning to see the benefits of intensive infrastructure spending and public health initiatives, Hamilton showed no such signs. Hamilton, like other "turn of the century" industrial cities, was characterized by a pattern of residential segregation. Segregated more along the lines of socio-economic class than ethnicity or religion, Hamilton's wealthy wards had average land values three times higher than the poorer wards (Gagan, 1989, 163). In 1910, population densities by ward ranged from 4000 persons per square mile in the wealthiest wards to 16 000 in the predominantly working-class wards (Gagan, 1989, 163). This latter figure was comparable to density levels in many of the worst U.S. cities such as Boston and New York (Conzen, 1987, 367). The densely populated wards were also characterized by two or three families living together in small houses or apartments compounding the adverse effects of being without sewers. Like other North American cities at this time, Hamilton's infants were particularly susceptible to gastro-intestinal diseases which were generally the result of poor living conditions (Condran and Cheney, 1982, 107-113; Condran and Crimmins, 1980, 194; Conzen, 1987, 368; Gagan, 1989, 165-166)

In 1900, seventy per cent of Hamilton's infant deaths were caused by digestive diseases; ten years later 77 per cent of infant deaths were of the same causes despite the fact that overall mortality from digestive diseases had dropped by 33 per cent during that span (Gagan, 1989, 164). This suggests that overall living conditions had improved, but in some areas, such as those still without sewers and fresh water, the conditions for poor infants remained unhealthy (Gagan, 1989, 165). Reflecting the general trend of the time in Canada, Hamilton's infant mortality rate in 1900 was 172.5 per thousand births, but by 1910 it had dropped to 116.4 perhaps due to overall improvements to the city's sanitation system (Gagan, 1989, 167; McInnis, 1990b, Plate 29). Furthermore, the lowest relative percentage of infant deaths occurred in the two wealthiest and least populated wards, while the three poorest wards were home to 36 per cent of the population, but over half of the infant deaths (Gagan, 1989, 167). Gagan concludes, not unexpectedly, that the lowest incidence of infant mortality occurred in the wards with the lowest population density, highest property value, most sanitation services and lowest percentage of employees working in industrial and thus low paying jobs. Similar patterns can then be expected for Ottawa, and will be examined in some detail in the following chapters. The connections that Gagan has highlighted between areas of higher infant mortality and poorer living conditions and standards versus other areas will also be pursued in some depth later in this thesis.

Thornton and Olson's 1991 study of mid-nineteenth century Montreal and the incidence of infant mortality is the most similar to the work undertaken in this thesis. The authors' objective was to examine whether or not infant mortality was simply a

reflection of socio-economic status as has been concluded in most studies of the issue to date (Thornton and Olson, 1991, 402). Montreal's infant mortality rate was the highest in Canada at the turn of the century and the city was widely recognized as one of the unhealthiest industrial cities in North America (McInnis, 1990, Plate 29; Thornton and Olson, 1991, 402). In Montreal, the major cultural divisions were based on language and religion which made it unique in North America and thus an attractive location for further study. Like almost all cities, residential segregation existed in mid-nineteenth century Montreal. However its spatial distribution was determined by language, ethnicity and religion as well as socio-economic status. This makes it an attractive model for the study of Ottawa and Lowertown because much of the segregation there, as will be explored further in the next chapter, is of the same form (Thornton and Olson, 1991, 403).

Each of the 1859 Montreal infant deaths studied were classified into three ethnic groups; French Canadian, Irish Catholic and Protestant, as well as six socio-economic categories based on the father's income and occupation (Thornton and Olson, 1991, 403). Each death was also given a location index based on the block-face in which the family resided and some of its characteristics such as; elevation, population density, rent or property value of the dwelling and the median rent of the block-face (Thornton and Olson, 1991, 403). In Montreal, ethnicity and religion seemed to be the most salient descriptor of life and therefore rent of itself did not explain different infant mortality rates. Each ethno-religious group was represented by people of each economic class, therefore economic class, as reflected in rental costs,

does not differentiate between those with infant deaths and those without. Yet, as rent increased, the incidence of mortality was seen to decline for each group (Thornton and Olson, 1991, 405).

Thornton and Olson tried to link the variation in infant mortality to cultural differences, such as breast feeding practices and/or spacing between births. No evidence exists to suggest that one group breast fed its babies more or less than another, but Thornton and Olson contend that a higher infant mortality rate among French Canadians could be the result of a general practice of breast feeding their infants for less time than did mothers of other ethno-religious groups (Thornton and Olson, 1991, 406-409). Moreover, the Jewish families of Montreal towards the end of the nineteenth century were found, by Copp, to breast feed more often than other ethno-religious groups and had substantially lower rates of infant death (Copp, 1974, 96). This link, therefore, centres around the problems associated with the artificial feeding of infants in the nineteenth century and the contaminated milk used. An alternate explanation which Thornton and Olson suggest is that since French Canadian families experienced a higher infant death rate and also practiced a system of rapid replacement of infants that died, more stress was placed on the mother which further decreased the chances of survival for subsequent children (Thornton and Olson, 1991, 410).

In summary, the available research shows that infant mortality was decreasing in the late nineteenth century, more so in Europe and Britain than in North America, but nonetheless the chances of infant survival had increased since the middle of the

century. Higher infant mortality rates were associated with rapidly expanding, large urban, industrial centres that had an unequal distribution of wealth along with poorly developed sewage and garbage removal systems and inadequate sources of fresh water for domestic use. These conditions often resulted in seasonal deaths from digestive and diarrhoeal diseases. Infant mortality was characteristic of cities and districts with residential segregation along ethnic, religious and socio-economic lines. With these factors in mind the focus of this paper now shifts to the study of the city of Ottawa at the turn of the century.

Conclusions:

Through the industrialization of the economy and the resulting rural to urban migration, population growth and immigration of the eighteenth and nineteenth centuries the processes of industrialization and urbanization in Europe and North America gave rise to the cities of the late nineteenth century. These newly industrialized cities often contained residentially differentiated communities with some residents living in squalid conditions which were conducive to higher rates of infant mortality. The review of the literature provided in this chapter suggests three areas that contributed to variations that existed in the infant mortality rates; economic, social and housing conditions. The literature clearly suggests that infant mortality was most characteristic of districts where economic and housing conditions were at their worst. In many of these late nineteenth century cities the areas with the worst living

environments were also the areas that were socially distinct from the rest of the city. Economic variables germane to the study of Ottawa appear to be income, social class, property assessment and occupation. Social factors include indicators of "difference" such as ethnicity, language, literacy and religion. Housing factors include location, type of housing, size of dwelling in addition to indicators of crowding such as size of family. Later in this thesis, each of these factors will be examined in the context of early twentieth century Ottawa, and Lowertown, in order to establish any links with the rates of infant mortality that existed at that time. The purpose here is to determine which factors were most likely to be related to higher rates of infant mortality in the city and to gain a clearer understanding of the environmental conditions that existed in "Turn of the Century" Ottawa. Establishing causation is not the objective of this thesis.

Before moving on to the determination of the specific links between the social environment of Ottawa and the infant mortality rate, the origins of the city and how they influenced the development of the turn of the century city must be examined. What impact did the natural setting of Ottawa on the shores of the Rideau and Ottawa rivers have on the settlement patterns of its residents? How did the various economic and political phases of the cities' development contribute to its 1901 pattern? In terms of the various important socio-economic variables, was Ottawa homogeneous? How was Lowertown different from the rest of the city? Each of these questions will be examined in some detail in the next chapter.

Chapter Three:

The History of Ottawa to 1901 and the Patterns of Residential Differentiation

Introduction:

At the turn of the century, cities were often, but not exclusively, divided by social class; Ottawa was no exception to this pattern. Sometimes these class differentials were determined by occupation and income, as seen in some of the most heavily industrialized cities of North America such as Hamilton, Detroit, Cleveland and Pittsburgh. On the other hand, in many other cities, such as New York and Montreal, the essential component to social and residential differentiation was, and still is, cultural or social in nature, such that race, ethnicity, language, and religion were often the defining factors of this 'segregation' (Conzen, 1987, 366). Such classic 'ghettos' existed in many cities such as New York's Bronx area with African-Americans, the Chinese in Toronto's 'Chinatown', the 'Little Italies' of New York and Boston, the Jews in Montreal, not to mention the many large communities of people of British descent. This pattern of segregation and concentration, or spatial differentiation began to develop during the earliest days of urban development in North America. This chapter will examine this patterns of segregation and fragmentation as they occurred in the early development of Ottawa.

Many factors contributed to the pattern of ethnic, religious, linguistic, and economic or class segregation that existed in Ottawa at the turn of the century. The

history of the city's development in terms of its economic and industrial growth, the introduction of federal politics and government to the city and its social demography will all be examined in some detail. The first part of this chapter will show how the development of Ottawa's economy and social structure produced a segregated and fragmented city. The second part will investigate the differences between the different 'regions' of the city and, more importantly, will show how Lowertown was significantly different from the rest of the city. This will provide an introduction to the study of the living conditions and social environment of Lowertown in 1901 which follows in Chapters Four and Five.

History of Ottawa - Beginning to 1901:

Many factors went into the long process of developing the site of present day Ottawa-Hull. Many of these factors were related to the wider geographical setting in which the city was established. The city is located on the Ottawa River, at the site of the Chaudière Falls. Historically, the Falls interrupted travel on the Ottawa and required that travellers 'portage' at the site. Settlement, therefore, grew around the need to provide services to these travellers. The Falls, of course, also provided a power source for the operation of mills. To the north of the Ottawa River and the present day site of the city of Hull, Quebec, lie the Gatineau Mountains, part of the Canadian Shield. On the south side of the Ottawa River, the city of Ottawa sits on a relatively flat plain of sedimentary rocks which are part of the St. Lawrence lowlands

Figure 1 - Southern Ontario

Scale: 1:3 864 880

(Source: Based on Taylor, 1986, 50)

(Fulton, 1987, 5). Nearby are the Rideau Falls, where the Rideau River joins the Ottawa from the south, and across the river the Gatineau River flows in from the north to join the Ottawa as well. The confluence of these three rivers and the Chaudière Falls made the location a natural setting for a nineteenth century settlement. The modern history of this settlement began at the turn of the nineteenth century with the settlement of Wright's Landing, established by American Philemon Wright, his family and followers. However, this site had been well known to many Europeans and Natives for many decades before.

River travel had been key to the movements of the Native population of North America for centuries; the Ottawa River was one of the main routes for the Algonquins (Eggleston, 1961, 66). Some evidence exists to suggest that the portage at Chaudière Falls was a meeting and trading place for different groups of Algonquins many years before the arrival of the European explorers. No records exist today, but indications are that the first European to travel up the Ottawa River was Etienne Brûlé in 1610 (Eggleston, 1961, 66). For most of the next two centuries, the Ottawa was used as a highway to the centre of the North American continent by explorers, fur traders, missionaries, soldiers, coureurs de bois, and Natives. In 1613, Samuel de Champlain was the first explorer to document the Chaudière Falls and the bluffs on which the modern Canadian Parliament now sits (Figure 2) (Eggleston, 1961, 68). As the largest portage between Montreal and Lake Nipissing, the Chaudière Falls represented a logical place to stop and make camp. The Ottawa River was not the only important transportation route of the area in these pre-settlement days. The

Rideau River was also used for canoe travel, as only a few short portages separated the Ottawa River from its head waters in the Rideau lakes and from there a navigable route to the St. Lawrence River at Kingston existed.

The entire Ottawa River valley was densely forested and initially this slowed the settlement process of the area. These same forests, however, would later become the lifeblood for those who chose to settle in the valley. Surveyors first arrived in the early 1780s, but they determined that the area was not suitable for agricultural settlement because of the dense forests and the rocky soil and so did not lay out a town site at that time (Woods, 1980, 16). However, only ten years later the south shore of the Ottawa River, just below the Chaudière Falls, was staked out by civil land surveyors; private land speculators also staked claims to land about the same time. The site of the first settlement in the area, Wright's Landing, later Wrightstown, was established by American Philemon Wright and his family and followers in the early years of the nineteenth century on the north shore of the Ottawa River at the Chaudiere Falls. They were searching for a location for their 'utopian' agricultural settlement, but soon took advantage of the other economic opportunities provided by the location such as transportation, hospitality, and logging (Taylor, 1986, 11). The portage, as well as the natural power source supplied by the falls helped make the settlement a success.

The effect of Wright's settlement was small at first, as only 1000 settlers had set up homes, mostly on the north side of the Ottawa by the outbreak of the War of 1812 (Taylor, 1986, 12). By the end of the War, the British government had

determined that Upper Canada was in need of defence from potential American invasion and recognized the military importance of both the Ottawa and Rideau Rivers as lines of communication. The British also realized the vulnerability to American attack of the St. Lawrence River between Montreal and Kingston (Figure 1). As the major commercial and military thoroughfare between the merchants and ports of Montreal and the military base at Kingston and the Upper Canadian frontier beyond, the St. Lawrence River was of strategic importance to the British. At the same time, the American construction of the Erie Canal, designed to capture much of the St. Lawrence River commercial trade, forced the British to consider either upgrading the St. Lawrence route or finding an alternate. The British military was more concerned about the security of the province than trade or commerce and so pushed for the development of an alternate route as well as increased military presence in the area. By 1818, a military settlement at Richmond, a village 30 kilometres inland from the south side of the Ottawa River at Chaudière Falls had been established (Bond, 1984, 29).

By the early 1820s, Wrightstown had a population of 1000, the surrounding countryside on the north shore was populated by another 1000 people, while the south shore was populated by close to 2000 individuals, mostly farmers (Taylor, 1986, 12). Although the agricultural production, primarily from the south shore, was increasing, and thousands of logs were being floated down the Ottawa River and its nearby tributaries, Wright and his family still held a monopoly on much of the commerce in Wrightstown. Moreover, the benefits from timber extraction were enjoyed mostly by

Quebec City industrialists. As a result of this typical frontier economic arrangement there was insufficient wealth and prosperity in the region to construct or finance the Rideau Canal locally. Thus, the construction and financing of the Canal ultimately became the responsibility of the British military (Mika, 1982, 53). In 1826, Lieutenant Colonel John By was placed in charge of the construction of the Canal by the Royal Engineers and British Ordnance - the official surveyors and military establishment of Britain in Canada (Mika, 1982, 49).

The distribution and purchase of lands in response to the canal construction determined the shape and nature of the city of Ottawa. In 1823, prior to construction, the Governor in Chief, Lord Dalhousie, purchased 400 acres on the south side of the Ottawa River directly across from Wrightstown for the development of the area (Bond, 1984, 33). It was on this land that a military barracks, a construction camp and a surveyed townsite with large lots for lease, were established by Colonel By who proposed that the canal he would build should pass through it. Directly to the south of the land which Dalhousie purchased on behalf of the British Ordnance was 200 acres of land owned by local speculator Nicholas Sparks. To the east of Sparks' property was a further 200 acres owned by Louis Besserer (Taylor, 1986, 17). The privately owned land belonging to Sparks and Besserer immediately restricted the growth of the townsite and this would later be important in determining the nature of the settlement pattern of the city (Figure 2).

Colonel By built several military and canal construction buildings in the first year and then laid out the town lots. The land to the east of the canal and military

Figure 2 - Early Land Ownership and Settlement, Bytown

(Source: Based on Taylor, 1986, 15 and 36)

reserves, though a cedar swamp, was laid out into generous town lots in 1826 (Bond, 1984, 39); this area would later become Lowertown (Figure 2). The only Ordnance owned land suitable for development was almost a kilometre west of the Canal on the bluffs overlooking the Ottawa River at the site of what would later become the western edge of Uppertown. This plot of land was directly opposite the land owned by Sparks and was laid out into lots smaller than those of Lowertown and the land was leased in perpetuity. Located directly up the bluffs from Richmond's Landing and near the road to the settlement of Richmond, this area soon became the home to many of the retired military officers formerly living in the town of Richmond. Along with the lots developed at the western end of Sparks' land, Uppertown soon became the centre of Anglo-Protestant life (Taylor, 1986, 17).

The cedar swamps in Lowertown were drained in 1827 in order to allow for the construction of a road to the wharf at the foot of the Canal and so the land became 'open' for settlement (Brault, 1946, 60). In contrast to the standard lease terms of the Uppertown community, By established a system of different lease terms for Lowertown settlement depending on the land's suitability for settlement (Taylor, 1986, 17). Some of By's closest friends and those of 'the civilian establishment' received the best land of Lowertown, often found along Sussex Street and overlooking the Ottawa River, at a low rent and in perpetuity (Figures 2 and 3). The poorer land was deemed less suited to settlement and was only available through short term leases. Naturally, for those that could not afford the relatively expensive Uppertown lots, and did not reside in the civilian 'barracks' which were erected for the Canal labourers,

the poorer land in Lowertown, despite its unfavourable short-term leases, was the only alternative (Taylor, 1986, 17).

This land settlement pattern immediately created residentially differentiated areas based on class (Davis, 1954, 44). In this context, class is used as a broad-based term referring to the advantages and disadvantages held by people of various socio-economic standings. In other words, people and families of various occupations, degrees of accumulated wealth and land ownership potential received varying degrees of preferential treatment with respect to land occupation in early Ottawa. The most favoured of the social hierarchy owned their property on the land laid out by Sparks, the next class held land in perpetuity from Ordnance in Uppertown. The next group owned or leased land from Ordnance, or from Sparks, Besserer, and By himself and then often rented housing or commercial buildings to the landless at inflated cost (Taylor, 1986, 20). The landless either rented from these groups in Lowertown, squatted in distant land along the Rideau River or settled in a squatter camp, known as Corktown, along the Canal embankment (Brault, 1946, 62).

Although social differentials were apparent from the outset of the city's development so too were the differences relating to ethnicity and religion. The Uppertown residents were almost exclusively English speaking and of either English or Scottish descent and attended either the Anglican or Presbyterian churches. Lowertown, on the other hand, was almost exclusively Roman Catholic and of mixed Irish and French ethnicity. These social, ethnic, linguistic and religious differences between Uppertown and Lowertown were maintained throughout the nineteenth and

into the twentieth century.

The nature of European settlement in the first few decades of the nineteenth century in the Ottawa River Valley at the Chaudière Falls site determined the pattern of growth and development of the city for the rest of the century. Several other important phases of development occurred during this century to help reinforce this pattern and did not significantly alter it. By the time the Rideau Canal was completed in 1832, it was widely understood by the British military, local residents and the merchants and industrialists of Montreal, Quebec City and abroad that the Canal was not going to be an economically viable alternative to the St. Lawrence River (Taylor, 1986, 23). The military, however, still regarded it as an important element in the defense of Upper Canada.

Throughout the nineteenth century Bytown boosters believed that the Ottawa River, not just the Rideau, would play a key role in the economic prosperity of the province. They pushed the British government to consider a plan for an Ottawa River Canal to connect Ottawa, and thus Montreal, with the centre of the continent via the Upper Great Lakes (Taylor, 1986, 25). The boosters believed that this new canal would help transform the Ottawa Valley from a backwoods society into an agricultural and transportation axis to the centre of North America. Although this plan failed, the economy of Bytown grew steadily as agricultural activity increased throughout the newly cleared and harvested forest lands of the south shore of the Ottawa River and along the banks of the Rideau River and Canal. As agriculture was growing in importance around Bytown, the town was also growing due to the development of the

local timber industry. The early decades of the timber industry had limited economic impact on Bytown itself. Shanty men and lumbermen harvested the timber upstream and floated with it to the Chaudière or Rideau Falls, at which point the timber rafts were dismantled for passage around the falls before being reassembled for the voyage further downstream to Montreal or, more often, Quebec City (Mika, 1982, 120-121). The initial impact of the timber industry on the town, therefore, was due largely to trade undertaken by the shanty men while in town. The 1830's was a slow decade for economic and population growth in Bytown as a terrible depression kept the demand for timber down. The economy turned around at the beginning of the 1840's and then Bytown began to prosper (Taylor, 1986, 31).

Lower land costs, proximity to the steamship wharves, and a higher concentration of people allowed Lowertown to become a moderate commercial centre during this period. Goods arriving in daily steamships from Montreal and agricultural products from the surrounding countryside were sold and traded in the many new merchant shops established in Lowertown. Seasonal workers congregated in Lowertown either on their way to or from the lumber camps upstream or while they awaited employment opportunities harvesting crops for the local farmers. The 1840s, therefore, saw the emergence in Lowertown of many new merchant shops, tanneries, breweries and foundries as well as the construction of many boarding houses, brothels, gaming houses and hotels to house and entertain the transient workers (Mika, 1982, 150). Although many buildings were constructed during this era, the short term lease agreements on the lots in Lowertown resulted in many of the buildings being poorly

and hastily constructed and poorly maintained, while those few built in Uppertown were more likely to be constructed out of stone and better maintained (Newton, 1980, 21 and 29).

As discussed earlier, Bytown developed in a pattern that saw the two areas of Uppertown and Lowertown (Figure 2) act virtually as two distinct towns. Lowertown with land owned exclusively by the British Ordnance grew rapidly throughout the 1830s, 1840s and 1850s, while Uppertown, owned by either Ordnance or Sparks, grew more slowly as lease agreements there were much more restrictive (Newton, 1980, 29-30; Taylor, 1986, 38-39). This resulted in the perpetuation of the social divisions that had existed since the town's inception. Bytown's growth beyond the initial 400 acres of Ordnance lands purchased in 1823 and Spark's 200 acres was restricted due to further private ownership of large tracts of land. Monopolistic control of land in Wrightstown by Philemon Wright, and in New Edinburgh, at the eastern side of the Rideau Falls by Thomas McKay, allowed for the growth of small, yet competitive family owned townsites (Woods, 1980, 29, 79). Besserer's land to the south-east of Bytown, Colonel By's land to the south of both Spark's and Besserer's land, and the LeBreton estate to the west of Bytown all remained largely undeveloped until the 1850's (Figure 2) (Taylor, 1986, 35). These large estates on the outskirts of town were also surrounded by a slowly developing rural landscape which supplied grain and other agricultural products to the mills and markets in town. These, in turn, supplied the residents of Bytown, the lumber camps of the Ottawa River and nearby tributaries and to a lesser degree the markets of Montreal and beyond.

As the 1840s drew to a close, Thomas McKay of New Edinburgh, the main controller of the Rideau Falls, saw an opportunity to extract more value from the timber that was being transported through the Rideau River system. In 1848, he constructed a lumber mill at the Rideau Falls, where timber was either sawn into squared logs or converted to planks for construction purposes (Woods, 1980, 55). Not to be outdone, several of the lumbermen that controlled the Ottawa River timber industry constructed similar mills at the Chaudière Falls in the early 1850s. Thus a new era began in the development of Bytown. The new mills needed to be constructed and operated and so semi-permanent employment was created in the lumber industry. Some local industries developed from this, but still much of the 'processed' lumber was transported down river and overseas for further processing into manufactured goods (Taylor, 1986, 56). Nonetheless, some new economic activity was created for the region. This new economic activity was enough to spur the residents of Bytown to push for the town to be changed to a city and so in 1855 Bytown became the city of Ottawa. Although data on Bytown's population for this period are somewhat unreliable, Taylor has compiled some figures from a number of sources (Table 3).

Table 3 - Select Population Figures for Bytown, 1828 - 1851

	1828	1836	1841	1847	1851
Bytown	1000	3000	3122	5000	7760

(Source: Taylor, 1986, 210)

As lumbering activity increased, Ottawa boosters again encouraged British authorities and the "railroad tycoons" to make Ottawa a hub of the emerging rail-road network of North America. They pushed for a trunk line to run from Montreal and the eastern North American markets through Ottawa and up the Ottawa Valley to the Upper Great Lakes and beyond. As with the dreams of Ottawa boosters for the Ottawa River Canal, the Ottawa trunk line lost out to the St. Lawrence route for the Grand Trunk line (Taylor, 1986, 47-49). Ottawa did, however, eventually get a railway connection, although not to Montreal but south to Prescott. Thomas McKay had been a big supporter of the proposed Bytown-Prescott Railway and so when it was completed in 1854 it was of no surprise that the route ran through much of McKay's properties, past his two Rideau Falls mills and ended at a terminal in the northeastern section of Lowertown (Brault, 1946, 190; Mika, 1982, 199-200) The railway soon ran into trouble however, because the mills at Chaudière Falls and the nearby Lebreton community rapidly exceeded McKay's mills in economic importance.

The Chaudière Falls area of the Ottawa community had played an important role in the development of the city from the beginning, but it was the introduction of the lumber mills there that helped create an industrial and residential neighbourhood in the surrounding flats that would later become known as LeBreton Flats. In 1854, E.B. Eddy constructed a lumber mill and subsequently, a factory for making matches on the Quebec side of the falls. On the Ottawa side, John Booth became the largest and most powerful of the lumber barons of the Ottawa Valley when, in 1857, he purchased the timber rights to the extensive property of John Egan, probably the single

largest holdings in the Upper Ottawa Valley. In 1859, Booth's wealth increased dramatically when he secured the contract for the supply of much of the lumber for the soon to be constructed Parliament buildings of the United Province of Canada (Woods, 1980, 133). Unlike Uppertown and Lowertown, the LeBreton community at this time, was residually mixed in terms of class, and ethnicity. Many of the lumber barons, including Booth, made their homes in the area, as did many of the labourers for the lumber mills and related industries.

With the selection of Ottawa as the capital of the United Province of Canada in 1857, and the beginning of construction of the Parliament buildings in 1859, Ottawa began a new era in its development. Construction of the buildings brought some wealth to the city, but much of the skilled labour and materials had to be imported from other regions of Canada (Taylor, 1986, 61). By the time of the first meeting of Parliament in the new buildings, on the old site of the Rideau Canal construction barracks overlooking the Ottawa River, Ottawa was still largely a two industry city. Lumber provided much of the "raison d'etre" for Ottawa, but still the single largest employer was the service industry in its many forms; accommodation for seasonal employees, goods distribution, and entertainment.

By the end of the 1860s, Lowertown was still thriving. Commercial enterprise was growing as was the population of the predominantly Catholic residential community surrounding the commercial core. However, the mix of Irish and French that had characterized Lowertown from the beginning of the city's development had begun to change. Presumably, since the Irish had language in common with the

Figure 3 - Principal Streets of Ottawa, 1901

(Source: Based on DesRosiers, 1912)

Figure 4 - Wards and Regions of Ottawa, 1901

(Source: Based on DesRosiers, 1912 and Taylor, 1986, 114)

Scottish and English of Uppertown and LeBreton, they were better able to move up the social hierarchy and out of the depressed and dilapidated housing of Lowertown than were the French. Uppertown and the newly emerging Sandy Hill area, located on Louis Besserer's property (Figures 2 and 4), changed little from mid-century to the end of the 1860s. LeBreton, like Lowertown, thrived during the two decades from 1850 and became the mixed ethnic working-class district (Fear, 1979, 38-41; Taylor, 1986, 64).

The last three decades of the nineteenth century in Ottawa were marked by the continued presence of the lumber industry, the newly arrived government sector and the small scale service sector that continued to cater to these two industries. With the arrival of government in Ottawa, the social structure of the city changed. Many middle-class civil servants and wealthy Members of Parliament arrived in the late 1860s and helped change the residential landscape of certain parts of the city. Many of the Members of Parliament moved into Besserer's Sandy Hill area and created a wealthy suburb that was mixed ethnically, religiously and linguistically (Bond, 1961, 49). French and Anglo Canadian members settled in this exclusive neighbourhood together, the defining characteristic of this community being its economic class.

On the other hand, civil servants, and related businessmen, many of whom were of the new middle-class, resided in either Uppertown or Lowertown depending on their linguistic and ethnic background and denominational faith (Taylor, 1986, 64). French, and some Irish Catholics lived in Lowertown, while Protestant Irish, Scottish and English moved into Uppertown (Table 4). Thus the characteristics of both

Uppertown and Lowertown did not change significantly over the nineteenth century with economic class and cultural origins providing the dominant basis for settlement in each area. By the 1870s, to these enduring elements of Ottawa's residential and social structure, two new areas where economic standing or class, on its own, was the only major defining feature were added. These were Sandy Hill, home to the wealthy, and LeBreton, the working-class area associated with the lumbering and construction industries.

Table 4 - Distribution of Population by Ethnic Origin, Ottawa 1871 & 1901

	Lowertown	Uppertown	Sandy Hill	LeBreton	Total
1871					
French	5709	154	379	972	7214
Irish	3416	1929	1502	1174	8021
English	1102	1100	908	611	3721
Scottish	538	784	622	341	2285
Total	10876	4039	3474	3156	23545
1901					
French	12103	1444	2187	3293	19027
Irish	2591	8524	3180	3189	17484
English	988	6636	1865	2134	11623
Scottish	412	4462	954	1013	6841
Total	16863	22041	8807	9929	57640

(Compiled by the author from the Census of Canada, 1871 & 1901)

Overall, the distribution of people of French, British and Irish ethnicities did

not change much in the final thirty years of the nineteenth century. It is apparent that the pattern had been set by as early as 1871, if not before. Despite an increase in overall population for Ottawa in the order of 145 per cent between 1871 and 1901, the relative percentage of that population of each of the four main ethnicities did not change significantly. Both the French and Irish communities remained at slightly over thirty per cent of the city's total, while the Scottish community remained constant at about ten per cent. The proportion of the city population with English ancestry grew by about five per cent over the intervening years, which coincided with a similar sized decrease in the proportion of the population with 'other' ancestral origins. Details about the different ancestral origins of the people residing in each of Ottawa's four major areas; Lowertown, Uppertown, Sandy Hill and LeBreton, in 1901, will be discussed in more depth later in this chapter.

The turn of the century proved to be the end of the boom for the lumber industry in Ottawa (Bond, 1984, 56). A depression in the 1890s wiped out many of the smaller lumbering operations and a devastating fire in April of 1900 destroyed most of John Booth's lumber mills and yards as well as the houses of the industrial working-class in LeBreton (Fear, 1979, 41). Although Booth rebuilt his empire, the region and the industry were never the same. The LeBreton community began a long period of decay. LeBreton, along with Lowertown, became the receiving area for many new immigrant communities that began to arrive in the 1890's from Europe. Relatively large populations of Italians and Eastern Europeans settled in the LeBreton area, while Jewish immigrants settled, for the most part, in Lowertown (Taylor, 1986,

124).

The depressed economy of the 1890s, along with the influence of government to the eastern end of Uppertown combined to help shift the commercial core of the city from Lowertown to Uppertown. Trotman, however, argues that throughout the nineteenth century the central business district of Ottawa was located in two separate nuclei, one in Lowertown and the other in Uppertown; each supplying its own local community (Trotman, 1977, 87). The difficulty of crossing the canal and the delayed development of the area of central Ottawa, to the immediate west of the canal due to early land ownership practices of British Ordnance, seem to have fostered this pattern. Trotman argues that the introduction of intra-city transportation, the development of much of this central portion of the city by the government, the increased wealth accumulated by Uppertown residents and the depressed economic fortunes of Lowertown labourers as a result of the late nineteenth century decline in demand for lumber, all combined to help foster this apparent increased concentration of economic activity in Uppertown (Trotman, 1977, 87-116). This movement of the commercial cores in the late nineteenth century from Lowertown and western Uppertown to central Ottawa (eastern Uppertown) allowed for them to be re-built in the style of other Victorian cities. Along with the construction of modern multiple storey Victorian commercial and other elegant buildings, Uppertown also saw the introduction of gas street-lights in 1885, and electric powered street cars in 1891 (Brault, 1946, 138-138).

The nineteenth century was one of tremendous growth in all of Canada, and Ottawa was no exception (Table 5). With its beginnings as a trans-shipment point in

the early 1800s to a strategic military initiative in the 1820s, to a booming timber and then lumber centre of the 1830s through 1880s, and a government centre for the final three decades of the century, Ottawa grew to become a significant Victorian city by 1900. The rate of population growth showed the expected decline through time, but the absolute numbers increased until 1901, at which point Ottawa was home to 57 640 people and was the only city in Carleton County (Census of Canada, 1851-1901). The economic and political changes that occurred over the century helped to create the residential landscape as seen in 1901. After having outlined the origins of these patterns of urban settlement, a more thorough investigation of the specific differences between the community of Lowertown and the rest of the city as seen in 1901 will follow.

Table 5 - Population Growth, Ottawa, 1851 - 1901

Population (and Change) in:					
1851	1861	1871	1881	1891	1901
7760	14669	23545	30412	42481	57640
	(+89%)	(+61%)	(+29%)	(+40%)	(+36%)

(Source: Compiled by the author from the Census of Canada, 1851 - 1901)

Ottawa in 1901:

In the following section, the objective is to reconstruct the pattern of specific variables in 'turn of the century' Ottawa so that it becomes apparent that the city consisted of several different 'regions', and that Lowertown was significantly different from the rest of the city. Ideally, this reconstruction of the urban landscape would take the form of a detailed examination of the many different social, economic and physical environmental factors. However, published data at the ward or 'regional' scale are limited. Data on income and occupation and other variables are available only in the manuscript form of the 1901 census and cannot be readily compiled to the ward scale. Other characteristics are also available in the published volumes of the census. However, they are unfortunately aggregated to the city level which allows for inter-city, but not intra-city, comparisons. Yet, through the use of some of the available published data from the 1901 census, in conjunction with data abstracted from the manuscript volumes of the census for Lowertown, some significant conclusions can be drawn about the differences between Lowertown and the rest of the city. Five broad characteristics are seen to differ between Lowertown and the rest of Ottawa. The first four characteristics; ethnicity and language, religion, housing, and population density will be examined here and the fifth characteristic, infant mortality, will provide the focus for work presented in the remainder of this thesis.

Much of the discussion in the remainder of this chapter and the rest of this thesis, will focus on the regions of Ottawa. In the context of this thesis the term

region is used to describe a unique and distinct community. Ottawa in the nineteenth century, as described here, consisted of four distinct regions, not necessarily based on geo-physical attributes; Lowertown, Uppertown, Sandy Hill and LeBreton. Each, as will be discussed throughout the following chapters, is distinct in terms of its social and political characteristics and economic and housing conditions. None exists as a political entity, but each has long been considered a relatively homogenous region. In the early years of municipal politics, Lowertown counter-balanced the region of Uppertown. In 1855, for electoral purposes, the municipal government divided Lowertown into two distinct wards; By and Ottawa (Figure 4) (Taylor, 1986, 68). In 1889, Wellington Ward, which had represented the region of Uppertown since the formation of the city of Ottawa in the early 1850's, was subdivided into two wards; Wellington and Central (Taylor, 1986, 112). The two regions which entered into the political mix of Ottawa in the second half of the nineteenth century, Sandy Hill and LeBreton, were represented by St George's Ward (Sandy Hill) and Dalhousie and Victoria Wards (LeBreton). The structure of these four regions, and seven Wards will be central to the discussion in the remainder of this chapter.

Located directly between two distinctly different provinces, Ottawa quickly became a city of mixed ethnicities with people of French and British origins accounting for almost 96 per cent of the 57,640 residents in 1901. Overall, Ottawa was 63 per cent British and 33 per cent French, but the pattern of ancestral origin among the four regions was quite different as the people of French and British origins were not evenly distributed among the seven Wards, (Table 6 and Figure 5). For

example, Lowertown, By and Ottawa Wards, were overwhelmingly populated by people of French ancestry, as over twelve thousand of the almost seventeen thousand Lowertown residents (72 per cent) had French ancestral origins. Of the remaining 4760 Lowertown residents over half were Irish, mostly Roman Catholic, a further third were of other British ethnicities, and the remaining twenty per cent of the non-French Lowertown residents were of either Jewish, German or Italian heritage.

Table 6 - Population of Ottawa's Wards by Ethnicity, 1901

	French	English	Irish	Scottish	German
By	5064	654	1393	213	22
Ottawa	7039	334	1198	199	139
Central	668	3539	3808	2280	331
Wellington	776	3097	4716	2182	218
St. George	2187	1865	3180	954	425
Dalhousie	2528	1565	2426	712	71
Victoria	765	569	763	301	42
Total	19027	11623	17484	6841	1248

(Source: Compiled by the author from the Census of Canada, 1901)

The region of Uppertown stood in contrast to Lowertown. Central and

Wellington Wards, the two Wards that made up Uppertown, contained only 1400 people with French ancestry, seven per cent of the district's total. Uppertown was largely home to people with ancestral ties to Britain. Over 8500 (39 per cent) of the Uppertown residents were Irish, mostly Protestant, a further thirty per cent were English, and the remaining twenty per cent were Scottish. As seen in the previous section this ethnic, and resultant linguistic, contrast between Uppertown and Lowertown was created and maintained throughout the nineteenth century by the economic and political forces of land ownership and control.

As regions that developed after the pattern of settlement of Uppertown and Lowertown had been established, Sandy Hill and LeBreton were somewhat more ethnically mixed than their older counterparts. The largest single ethnicity of the residents of the two LeBreton Wards, Dalhousie and Victoria, was French, but the region would by no means be considered French as only 33 per cent of the total population of LeBreton was French while 64 per cent was British. The Irish also comprised about thirty per cent of LeBreton's population while the English made up a further twenty per cent, and Scottish ten per cent. Small concentrations of Italians, Scandinavians and Chinese had also begun to settle in working-class LeBreton and they accounted for the remainder of the population. Although ethnically mixed as well, Sandy Hill was unlike LeBreton in terms of economic and social class. Next to Uppertown it had the smallest proportion of French residents, 25 per cent, and a large proportion of people with British ancestry.

Ethnic and linguistic clustering as was discussed in Chapter Two of this thesis

Figure 5 - Percentage of Population with French Ancestry by Ward and Region, Ottawa, 1901

(Source: Based on DesRosiers, 1912)

is a pattern seen in most North American and European cities, particularly after the mid-nineteenth century and is, in general, the result of the impact of industrialization and rapidly diverging socio-economic classes (Thornton and Olson, 1991, 403-404). The extreme concentrated pattern of ethnicities within Ottawa, particularly in Uppertown and Lowertown, suggests that even stronger concentrations may have occurred at the more local or street level in which case entire block faces may well have been of one particular origin.

Like many cities of this era, ethnicity was not the only identifying feature of the regions of Ottawa that was prone to clustering in particular areas. Specific religious denominations which often went hand in hand with ethnic origin, can also be seen to have concentrated in specific wards (Table 7). In 1901, over fifty per cent of Ottawa's population was Roman Catholic, mostly of French and Irish origin, while Anglicans and Presbyterians accounted for just 16 and 13 per cent of the total population respectively. The religious distribution within the two newest regions, LeBreton and Sandy Hill, reflected this overall pattern. In both of these regions, the Catholic population accounted for slightly over half, while Anglicans, Presbyterians, Methodists and Baptists accounted for the remaining half.

On the other hand, Uppertown and Lowertown represented the opposite ends of the spectrum. Uppertown was represented by a population that for the most part was evenly divided into three main religious denominations; Roman Catholic (26 per cent), Anglican (25 per cent) and Presbyterian (23 per cent). Methodists made up the majority of the remainder of the Uppertown population. Although on the surface this

region appears to have been a fairly mixed religious community, several points need further attention. The first, and most obvious point, is the general lack of a Catholic

Table 7 - Population of Ottawa's Regions by Religion, 1901

	Lowertown	Uppertown	Sandy Hill	LeBreton	Total
R. Catholic	14813	5759	4767	5186	30525
Anglican	826	5490	1777	1552	9645
Presbyterian	339	4963	865	1409	7576
Methodist	344	3467	123	1242	5706
Baptist	43	1066	230	275	1614
Jewish	289	24	67	18	398
Total	16863	22041	8807	9929	57640

(Source: Compiled by the author from the Census of Canada, 1901)

presence in Uppertown, as compared to the rest of the city. The second point is that although Presbyterians and Methodists did not make up an overwhelmingly large proportion of the Uppertown residents, at 23 and 16 per cent respectively, this was the core area of the congregations of these two Churches. Over sixty per cent of all Presbyterians and Methodists in Ottawa lived in Uppertown. As a final note to the religious nature of the community of Uppertown, the first Presbyterian, Anglican and Methodist churches of Ottawa were all built in this area indicating that most of the members of these congregations were local residents (Mika, 1982, 134-137; Ross,

1927, 125-126; Taylor, 1986, 36).

As was pointed out in the discussion of the ethnic segregation of Ottawa, Lowertown was predominantly of French and, to a lesser degree, Irish origin. Thus, it would come as no surprise that the Lowertown community was over 88 per cent Catholic. Two large French Catholic churches were built in Lowertown during the nineteenth century; Notre Dame Basilica at the western end of St. Patrick Street, and St. Anne's Church at the eastern end. Later in the nineteenth century, the Lowertown Irish Catholics felt compelled to construct their own church and so they built St. Brigid's Church midway between the two French Catholic churches. Small numbers of Anglicans, Presbyterians and Methodists also lived in Lowertown, about two per cent each. A strong community of Jewish residents existed in Lowertown at the time and members of the Adath Jeshurum congregation built a synagogue along King (Edward) Street around the turn of the century.

Often in tandem with ethnic and religious clustering comes linguistic divisions and this was the case in Ottawa. Language played a significant role in the clustering of the ethno-religious groups, as Lowertown was 86 per cent French-speaking, while Uppertown was 81 per cent English-speaking. With regards to culture then, turn of the century Lowertown can be characterized as having a strong French-speaking, French and Irish Catholic cultural identity, while Uppertown was characterized as being English-speaking, of British ancestry and having no one specific dominant Protestant religion. In contrast to these two cultural extremes are the two 'suburban' regions, Sandy Hill and LeBreton, with mixed ancestry and religious affiliations. It is

clear, despite the lack of data in support, that these two latter districts, although similar in cultural make-up, were substantially different in terms of economic class. Despite data limitations in assessing the differences between Sandy Hill and LeBreton in terms of economic class, Taylor, Woods and McDonald have all written extensively on this issue and are clear that such distinctions existed (McDonald, 1983, 61; Taylor, 1986, 84, 94 & 97; Woods, 1980, 134 & 204). Sandy Hill, despite its relatively late settlement quickly became the wealthy enclave of the city.

Between Confederation and the turn of the century Sandy Hill was transformed into a luxurious residential area noted for its stately homes. By 1900 there were more people of rank and title in this enclave than any other comparable district in Canada. (Woods, 1980, 204)

Meanwhile, LeBreton's identity as industrially working-class was fostered by the gradual movement of the local wealthy lumber barons from there to other locales, including Sandy Hill (Taylor, 1986, 94). Clearly then, the origins of Sandy Hill as a wealthy, upper-class, government community made it drastically different in terms of class from the predominantly working-class region of LeBreton.

Not only are there differences between each of the four regions of Ottawa in terms of cultural, social and economic factors, but there are also differences in terms of the physical or built environment. Factors such as population density and housing conditions can also be explored to highlight the differences between these areas. Population density has been recognized in many studies of urban living as having a significant impact on the standard of living, so it is an important and useful variable in distinguishing between regions with different living standards. Despite the fact that

the ratios for persons per family (family size), families per dwelling, and persons per dwelling (dwelling size) were all approximately equal for each of the regions, the density of persons, families and dwellings were all much higher in Lowertown than in any of the other districts (Table 8). The overall population density for Ottawa was almost nineteen persons per acre. Sandy Hill and Uppertown were close to the city-wide average with eighteen and seventeen person per acre respectively. LeBreton, with only 17 per cent of the total population and 27 per cent of the total land, had the lowest population density with only twelve persons per acre.

Table 8 - Population, Family and Dwelling Density by Region, Ottawa, 1901

	Lowertown	Uppertown	Sandy Hill	LeBreton	Total
Area (acres)	430	1300	484	829	3043
Population	16863	22041	8807	9929	57640
Population Density	39.2	17.0	18.2	12.0	18.9
Families	3105	4197	1607	1927	10836
Family Density	7.2	3.2	3.3	2.3	3.6
Dwellings	2838	3835	1549	1728	9950
Dwelling Density	6.6	3.0	3.2	2.1	3.3

(Source: Compiled by the author from the Census of Canada, 1901)

On the other hand, Lowertown had over three times as many people per

acre as did LeBreton and over double the city-wide average. Within Lowertown almost a third of the entire city population was living on one seventh of the available land. Similar results are found when looking at the average number of houses per acre and families per acre. Lowertown had twice as many houses per acre (6.6) and families per acre (7.2) as the city averages. The result of all of this is that while the remainder of the city seems to have been relatively homogenous in terms of population density, Lowertown was almost twice as densely populated which suggests that the conditions of living within Lowertown may have been considerably worse than elsewhere.

A 1915 Federal Plan Commission chaired by Holt examined the National Capital Region and made recommendations for the planning of the area. Much of the report focussed on the design of future transportation networks including the re-design of the railway terminals and bridges across the Rideau Canal and the creation of new Parliamentary buildings and boulevards. However, some of the report addresses the historical development of Ottawa. Figures six, seven and eight are taken from this report. They show the population density of each existing Ward in Ottawa in 1880, 1890 and 1900 respectively. Clearly, despite the smaller size of By and Ottawa Wards, the population located there is comparable to some of the much larger wards. From 1880, and as this chapter has shown probably much earlier, the population density in Lowertown far exceeds that of the other regions of Ottawa.

While it is apparent that the living conditions in Lowertown were considerably more cramped than in the rest of the city, it is also interesting to note the differences

Figure 6 - Population Density of Ottawa's Wards in 1880

(Source: Federal Plan Commission of Ottawa and Hull, 1915)

Figure 7 - Population Density of Ottawa's Wards in 1890

(Source: Federal Plan Commission of Ottawa and Hull, 1915)

Figure 8 - Population Density of Ottawa's Wards in 1900

(Source: Federal Plan Commission of Ottawa and Hull, 1915)

in the types of available housing in Lowertown versus the rest of the city. For Sandy Hill, LeBreton and Uppertown combined the housing stock was fairly evenly mixed between structures of brick (49 per cent) and wood (44 per cent) (Table 9). The remaining 6.5 per cent were made of stone, composite and other materials. In contrast, almost 73 per cent of Lowertown's housing was made of wood, while only 16 per cent from brick, 6 per cent composite and 3 per cent stone. The implication of this is that wood, as a much cheaper and less durable material to build with, shows that the economic standards of living in Lowertown may have been considerably lower than in the rest of the city. Structurally, wood houses are inferior to those of brick, stone or composite materials and so the quality of the homes in Lowertown may have

Table 9 - Housing Stock by Region, Ottawa, 1901

	Lowertown	Lowertown Per Cent	Rest of Ottawa Ottawa	Rest of Ottawa Per Cent
Wood	2061	72.6	3148	44.3
Brick	474	16.7	3495	49.1
Stone	88	3.1	165	2.3
Composite	172	6.1	217	3.1
Other	43	1.5	87	1.2
Total	2838		7112	

(Source: Compiled by the author from the Census of Canada, 1901)

been less than elsewhere. This pattern may also be a reflection of the continuation of

the land owning practices alluded to earlier, whereby short-term renters were less likely to build 'permanent' dwellings of stone or brick on land they do not own (Newton, 1980, 21).

Conclusions:

The physical location of Ottawa and its early land ownership practices contributed to the growth of two distinct communities within the city; Uppertown and Lowertown. Over the course of the nineteenth century, economic, political and social pressures furthered Ottawa's development as a residentially differentiated city. By 1901, Ottawa consisted of four distinct regions differentiated from one another by social, economic and environmental characteristics. Lowertown, in particular, was considerably different from the rest of the city. Lowertown residents were generally of French ancestry, belonged to the Roman Catholic church, spoke French, lived in densely populated neighbourhoods with predominantly wooden housing, and were employed in traditionally working-class and low-paying occupations. Because Lowertown was clearly the poorest region of Ottawa it is likely, given the conclusions drawn from the literature presented in the previous chapter, that the region's rate of infant mortality would be higher than elsewhere in the city. The next chapter of this thesis will begin the process of investigating infant mortality in Ottawa, and more specifically Lowertown, in 1901. Questions about the unequal distribution of infant deaths in Ottawa and what factors contributed to this unequal distribution will be answered there.

Chapter Four:

The Geographical Distribution of Infant Deaths in Ottawa, and the Causes and Seasonality of Infant Deaths

Introduction:

To this point, this thesis has shown that social, economic and political forces created a spatially differentiated city in which Lowertown was a district entirely different from the rest of Ottawa. Social indicators such as ethnicity, religion, and language were all distinctly different in Lowertown than in the rest of the city. Secondary sources showed that economic indicators such as occupation and standard of living were different between Lowertown and the rest of Ottawa. Additionally, housing conditions, as outlined by the primary research presented in Chapter Three, showed that Lowertown residents were poorer and worse off than those residents of the rest of the city.

In this chapter, the objectives are two-fold. The first objective is to examine the geographic distribution of infant deaths in the city as a whole, so that it becomes clear that infant mortality varied throughout Ottawa in roughly the same pattern as did the social, economic and housing conditions. In other words, based on the conclusions made in Chapters Two and Three, it is expected that Lowertown, with generally lower economic and housing standards and a unique social community, would be the location of a disproportionate number of the infant deaths in 1901. The second objective of this chapter is to focus on the specific causes and seasons of infant deaths in order to

gain a better understanding of the mortality issue. Which fatal diseases and illnesses were the most prevalent among Ottawa's infants, and were some more prevalent in certain times of the year or in specific locales within the city? Answers to questions of this nature form the basis for exploring the second objective of this chapter. The beginning of this chapter, however, is devoted to an overview of the methodology used in this thesis.

Methodology

The year 1901 was selected as the focus of study because it is the earliest year in which a record of infant deaths for the city, rather than the county, coincided with a national census. Municipal death records are available for the city of Ottawa from 1896 onwards and national censuses are available in Canada on a decennial basis from 1851 onwards. Additionally, 1901 proves to be a convenient year of study for a number of other reasons. It is nearly the midway point in the almost 200 years of settlement of the Ottawa area to date, and so allows for 'taking stock' of the living conditions and standards of living for the residents of the city at that point. Moreover, 1901 is a convenient point to study infant mortality because the year lies firmly within the public health reform era in Canada (MacDougall, 1990; Rutherford, 1984; Weaver, 1984).

Located at the city archives in Ottawa, the municipal death records contain information about each death in the city for each year. For the purpose of this study,

all deaths of those under one year of age were extracted from the municipal records (Province of Ontario Death Registry, 1901 - Ottawa and Carleton County). A total of 538 cases were found. The published volume of the Census of Canada identifies 323 infant deaths (Census of Canada, 1901, Vol IV, 282). The discrepancy between these two sources is problematic, but some of it can be accounted for by the census' exclusion of stillbirths and the deaths of foundlings that occurred in institutions. Of the 538 cases in the municipal records, at least 125 occurred in institutions such as the House of Bethlehem foundling home (97 deaths), House of Mercy Hospital (13 deaths), maternity hospitals (12 deaths) and the Salvation Army Rescue Home and Children's Shelter (3 deaths).

Work by Thornton and Olson on 1859 Montreal shows that over 20 per cent of all infant deaths that year in Montreal occurred in foundling homes or institutions (Thornton and Olson, 1991, 404). They also contend that almost all of the foundlings that ended up in these institutions died (Thornton and Olson, 1991, 407). Copp concurs with this notion of a 'death sentence' imposed on foundlings. He asserts that as late as 1924 in Montreal, nearly three quarters of all foundlings were dying in their institutional homes and over two thirds of them were dead before they were six months old (Copp, 1974, 85). In Ottawa, almost 27 per cent of all infant deaths were foundlings and the rate of survival, although vastly different from Montreal but still high, is presented below in Table 10. Despite this, like Thornton and Olson's study, these 125 Ottawa institutional deaths were excluded from further study here because of the lack of any data relating to their location and socio-economic condition. In

addition, ten deaths that occurred to families residing outside of the city of Ottawa, and a further 32 deaths which were recorded in the municipal records with no indication of where the infant died or where their family lived, were also excluded for the same reasons. However, these deaths, particularly those of the foundlings, represent a significant proportion of the total number of infant deaths and so warrant further investigation elsewhere.

Table 10 - Infant Death and Survival in the House of Bethlehem, Ottawa, 1901

Admitted during year between Oct 31, 1900 and Nov 1, 1901	241
Placed outside or returned to parents in said year	102
Died in said year	102
Remaining in Home on Nov 1, 1901	37
Survival Rate	57.8%
Mortality Rate	42.3%

(Source: Compiled by the author from the Annual Report of the Board of Health, Ottawa, 1901, 5)

Information from the municipal records for the remaining 371 infant deaths, including the 67 stillbirths, was recorded. For each of the deaths in the municipal registry, any information that would aid in the process of tracing the family to the 1901 census was recorded. The registry provided family name, religion and home address of the deceased child. Information about the nature of the death itself was also recorded such as the cause of death, the age at death, the month of death and whenever possible the name and sex of the child. Analysis of the information about

the death itself such as the month and cause of death as well as the sex and age of the child will be discussed in more detail later in this chapter. Based on the address given in the death registry all 304 deaths were plotted on a city map (Figure 10) to see if any significant pattern emerged.

The family name, religion and address of the family of the deceased child were used for tracing the family in the 1901 census. Many of the 371 deaths were traced to the address given in the death registry, while many others were traced to nearby addresses and in some cases to addresses a considerable distance away. Many others were untraceable and so further data could not be extracted. For those that were located within the census, additional information was added to their file. The name, ethnicity, sex, age, place of birth and occupation (when given) of the household head was recorded for the family of each traced infant death.

It was determined that a disproportionate number of the infant deaths occurred in Lowertown. Additionally, since Lowertown was such a unique community in relative terms of ethnicity, religion, language and standard of living, another search of the 1901 manuscript Census of Canada and the Ottawa city directories of 1900, 1901 and 1902, as well as other sources such as the Goade's Fire Insurance Atlas and the Assessment Rolls for the city was undertaken to attempt to trace all of the 160 Lowertown infant deaths (Assessment Roll, 1896; Census of Canada, 1901; Goade's Fire Insurance Atlas, 1901; Ottawa City Directories, 1900, 1901 and 1902). Eventually, 136 were confirmed, but unfortunately 24 deaths could not be confirmed with any other source. In this last instance, no indication could be found that the

families of the twenty-four lived in Ottawa at any time around 1901. Consequently, no information about the families' ethnicity, language, income, or house type could be recorded and so these observations were excluded from further analysis.

For the 136 confirmed deaths, many new variables were added to their files. In addition to examining the details of the household head as discussed above, data were also extracted for each member of the family as well as other people living in the same dwelling. The names of all residents, their age, sex, marital status, ethnicity, religion, birthplace, nationality, occupation, employment status, income, ability to read and write, proficiency in speaking English and French were all recorded. Other indicators were also determined such as family size, the number of families resident in the dwelling, the number of rooms in the dwelling, and the housing construction material used. To all of this was added the assessed value of property from the nearest available Assessment Roll, that of 1896 (Assessment Rolls - Ottawa, 1896). Although each of these variables were extracted for each family with an infant death, not all were used in the final analyses. Nationality, for instance, was excluded from analysis because in the 1901 Census it meant citizenship as opposed to ancestry.

At this point, a complete record of the 136 confirmed Lowertown deaths had been created from the above mentioned sources. Summary statistics on the nature of the families that had infant deaths were compiled from these data. In order to draw conclusions about these Lowertown deaths, it was necessary to place them within the context of Lowertown as a whole. Unfortunately, a lack of detail and specificity in the aggregate published data of the 1901 Census rendered comparisons with the more

specific data collected on the families of infant deaths not feasible. In these circumstances, the decision was taken to extract a sample for Lowertown from the manuscript census in order to create a proxy for the Lowertown population as a whole. The best method for such a sample of the Lowertown population was determined to be through the use of a twenty per cent stratified sampling procedure. Every fifth household was selected and data to match the households with infant deaths was compiled. This Lowertown sample consisted of 610 households, which represented approximately twenty (21.2) per cent of the 2838 Lowertown households, and a total population of 3459 (20.5 per cent of 16 863) (Census of Canada, 1901, Vol. I, 78). The proportions of the sample population for each ethnic and religious group approximated that of the Lowertown population as a whole and so the sample was accepted as representative of Lowertown (Table 11). As Figure 9 shows, the spatial distribution of the sample households is also representative. Among the areas represented in the sample with only a few households, or none at all, are blocks that were primarily occupied by non-residential uses such as churches, schools, hospitals and commercial businesses (see Figure 12).

For ease of computation, both the infant death and sample files were 'collapsed' into composites, where each family was represented by one record. For each family, regardless of whether they had an infant death or were simply part of the general sample, these composites contained the family name and address, the ethnicity, religion, birthplace, age, level of literacy and mother tongue of the mother and father, the total family income and the occupation of the head of the household, as well as

information about the type and size of the house, the size of the family and the number of families present in the dwelling, as well as the assessed value of the property.

Table 11 - Representativeness of Lowertown Sample

	Sample Population	Lowertown Population
Ethnicity:		
French	432 (70.82%)	12 103 (71.77%)
Irish	90 (14.75%)	2 591 (15.37%)
English	39 (6.39%)	988 (5.86%)
Scottish	23 (3.77%)	412 (2.44%)
Other	26 (4.26%)	769 (4.56%)
Religion:		
Catholic	520 (85.53%)	14 813 (87.84%)
Anglican	34 (5.59%)	826 (4.90%)
Presbyterian	18 (2.96%)	339 (2.01%)
Other	38 (6.23%)	885 (5.25%)

(Sources: Compiled by the author from the Census of Canada, 1901, Vol I, 78-79, 210-211, 338-339)

To this point, each composite record, for households in both the sample and infant death populations, had several measures of location, each representing a different scale or level of perspective. Each of the 610 sample households and 136 infant death families had been identified, from a broad to more specific locale, as having lived in Lowertown, in either By or Ottawa ward, in one of the twelve divisions, and on one of the 39 streets of Lowertown. The address for each household had also been established and so a micro-scale analysis also became feasible. Work by Thornton and Olson in Montreal and Smith and Frost in Adelaide had both made use, for different

Figure 9 - Distribution of Twenty Per Cent Sample of Lowertown Households, 1901

purposes, of the block-face as a dis-aggregating tool (Smith and Frost, 1994, 265; Thornton and Olson, 1991, 403). Through the use of the 1901 city directory, the streets of Lowertown were delineated into street frontages or block-faces. In the case of Lowertown, the entire region was dis-aggregated into 305 habitable block-faces. Several areas were deemed uninhabitable due to topographical limitations such as those areas along the bluffs overlooking the Ottawa River, and therefore, were not counted.

Among the 305 block-faces, 226 had at least one household from the twenty per cent sample living on it (Figure 9). Of the remaining 79 blocks, 75 did not have a sample household located on them for at least one of several possible reasons. Some block-faces were completely occupied by an institution such as a church, school, or hospital, while others were used for other non-residential purposes such as commercial, industrial or recreational. For example, several blocks were set aside for lumber piles or railroad supply depots, while others were used as parks and so they were not occupied by any residences. While these cases above explain the land use of many of these 75 block-faces, others were used as residential properties, but they were often sparsely populated and in some cases were occupied by only one or two private estates. These low density residential streets were not included for further study because they were simply excluded, by chance, in the sampling process and therefore no data had been recorded for them.

Among the 226 block-faces with at least one sample household, 86 or 38 per cent had an infant death. A further four block-faces had one infant death each, but since no sample household was located there, they were excluded from further analysis

because of this lack of comparative data. The block-face, along with the ward, division, street and address were used as measures of geographical location throughout the analytical components of this thesis.

Archival research and data collection permitted a comparative analysis of the two composite files; those households in the twenty per cent stratified sample, and those households with infant deaths. This analysis of the differences between the families with infant deaths and the rest of the families in Lowertown is provided in Chapter Four in an effort to establish which factors are the most highly associated with infant death. These factors have been grouped into three broad categories. Social factors incorporate ethnicity, religion, language, and literacy; the primary economic factors are, income, occupation and assessed value of property and the final category of factors is housing which incorporates the house type variable as well as housing and population density, and family size. However, before examining the socio-economic factors associated with infant death, the distribution of infant deaths within the city of Ottawa as a whole and an assessment of the causes and timing of infant death will be examined.

Infant Mortality in Ottawa - 1901:

Of the 371 traceable, non-institutional deaths in Ottawa in 1901, 67 were the result of stillbirths. Because the true definition of the infant mortality rate is the number of deaths under one year of age for every 1000 live births, those deaths that

were recorded as stillbirths were excluded, resulting in a base of 304 infant deaths. To date, little historical research on the incidence and causes of stillbirths has been undertaken, but a study in 1954 showed that over 42 per cent of the nearly 2100 stillbirths in Ontario in 1952 were the result of congenital malformations and diseases of the foetus that may have been related to environmental and living conditions (Sellers et al, 1954, 36-37). Despite this, the link between the living environment and stillbirths is tenuous at best, and since these cases were neither recorded as births nor as deaths in official records, they have been excluded from analysis in this project. It is clear, however, that more research into the causes of stillbirths and any links to social conditions and the environment is warranted due to the relatively high number of such cases at the end of the nineteenth century in Ottawa and elsewhere.

As the discussion in Chapters Two and Three has shown, it would be surprising to find an equitable distribution of infant deaths among each of the four regions or seven wards of Ottawa given the differing social and economic standings. In fact, the distribution of infant deaths is far from equitable and closely resembles some of the patterns already discussed in the previous chapter (Figure 10). The two Lowertown wards clearly had the most infant deaths with a total of 136 out of the 304 traceable, non-institutional and non-stillbirth deaths in the city as a whole (Table 12). This represents almost 45 per cent of all infant deaths, in a region that accounted for only 29 per cent of the population. Conversely, Uppertown families had 78 infant deaths, 26 per cent of the total, while they made up 38 per cent of the population. The two other regions, like in so many other cases, fell between these two extremes.

Figure 10 - Infant Deaths in Ottawa, 1901

(Source: Based on DesRosiers, 1912; Civil Death Registry, 1901)

LeBreton and Sandy Hill were each home to about one seventh of the population and infant deaths. Thus, for LeBreton and Sandy Hill the number of infant deaths in each region was proportional to the total population living there. On the other hand, Lowertown had proportionally more deaths than expected and Uppertown had fewer deaths than expected (Table 12). Chi-square tests showed that infant deaths were not equitably distributed at the 95 per cent confidence interval. At the regional level, the calculated chi-square value was found to be 36.46.¹ Since this exceeded the critical value of 7.81 with three degrees of freedom, the null hypothesis that there was no significant difference between the observed number of infant deaths in each of the regions of Ottawa relative to their proportion of the population was rejected. Therefore, infant mortality was found to be associated with location of residence in the city. In fact, there were areas that were over-represented (Lowertown) and others under-represented (Uppertown). At the ward level similar results were obtained. The chi-square value obtained was 43.41; the value required for rejection of the null hypothesis was 12.59 with six degrees of freedom at the 95 per cent confidence level.²

Further evidence of the concentration of infant deaths in Lowertown can be found by examining the number of infant deaths per thousand residents. By Ward had the highest number of deaths per one thousand members of its population, with almost 8.5 infant deaths for every 1000 residents. Ottawa Ward, with the single highest number of infant deaths (70) experienced almost seven and two thirds deaths per 1000 people. Combined therefore, these two Lowertown wards experienced eight deaths for every 1000 residents. At the other extreme, the two Uppertown wards combined for

only 3.5 infant deaths for every 1000 people, with Central Ward registering the lowest value for the entire city at only 2.5/1000. Meanwhile, LeBreton and Sandy Hill again fell between these two extremes with 4.6 and 4.99 infant deaths per 1000 residents respectively. There were almost twice as many deaths for every one thousand residents of Lowertown (8.0/1000) than for the rest of Ottawa combined (4.1/1000).

Table 12 - Observed and Expected Number of Infant Deaths by Ward and Region, Ottawa, 1901

	Percentage of Total Population	Observed Deaths	Expected Deaths
Lowertown (total)	29.26	136	89
By Ward	13.36	59	41
Ottawa Ward	15.90	77	48
Uppertown (total)	38.24	78	116
Central Ward	18.73	27	57
Wellington Ward	19.51	51	59
Sandy Hill (total)	15.28	44	47
St. George's Ward	15.28	44	47
LeBreton (total)	17.23	46	52
Dalhousie Ward	12.91	36	39
Victoria Ward	4.32	10	13
Total (all regions)	100.00	304	304

(Source: Compiled by the author from the Census of Canada, Vol I, 78-79)

Although not surprising, these results suggest that a clear concentration of

infant deaths occurred in Lowertown. Given the conclusions from Chapters Two and Three, it is likely that the patterns of ethnicity, religion, language, economic standards and housing conditions of Ottawa were related to this pattern of infant mortality. Lowertown was clearly different from the rest of the city in terms of these social, economic and housing factors; it also had a significantly higher infant mortality rate than the rest of Ottawa. This supports the conclusions drawn from the literature which suggest that the areas with the worst conditions or worst social environment are likely to have the unhealthiest children.

Due to a lack of available data at the ward or division scale for the city as a whole, this relationship cannot be pursued further. However, through the use of the twenty per cent sample of all families in Lowertown and the 130 families with infant deaths, comparisons of the social, economic and housing conditions between those families with and those families without infant deaths will be undertaken in Chapter Five. This will shed more light on the relationship between the social environment, as defined as the social, economic and housing conditions in which residents live, and the incidence of infant mortality. But first, it is important to look at the causes of death, and any seasonal pattern of death that might exist in order to further develop the link between infant deaths and environmental conditions.

Seasonality and Cause of Death:

Given the above conclusions that Lowertown's poorer social environment was

associated with the higher rates of infant mortality there, it is important to examine possible links between environmental conditions and the infant deaths. Evidence in the literature suggests that areas with high degrees of seasonal infant deaths and deaths from environmentally related illnesses, such as diarrhoeal diseases, are areas with poor living conditions. Analysis of the seasonality of death and the causes of death is undertaken in this section to support further the conclusions about the quality of the social environment that characterized Lowertown in 1901.

With infant mortality, not only are the geographic distributions and the associated social, economic, and housing factors important, so too are some of the aspects of the deaths themselves. For example, the causes of death, the time of the year that the death occurred, and the age of the deceased infant can all provide useful information on the nature of the infant mortality problem. Also, this type of analysis can often provide insights into the state of the living conditions that the infants and their families were exposed to.

Many of the most well known diseases of the nineteenth and twentieth centuries have been shown to have clear links to specific environmental conditions. For example, typhoid fever is clearly linked to the water supply. Efforts by local governments to produce a clean and filtered supply of water in the 1890's, but more often in the first decade of the twentieth century, had a tremendous effect on the incidence of typhoid (Condran and Cheney, 1982, 111). In fact, typhoid epidemics in Ottawa in 1911 and 1912 were the catalysts for urban water supply reform in the city (Lloyd, 1979, 67). A group of illnesses generally referred to as diarrhoeal diseases is

also connected to the food and water supplies, particularly for infants and children (Condran and Cheney, 1982, 114). During the 1870's and 1880's, urban reformers often encouraged the inspection of milk supplies as well as sources of water used for drinking and ice making (Condran and Cheney, 1982, 114). Food market inspectors were also hired to help reduce the number of diarrhoeal disease outbreaks. Terry Copp shows that in Montreal between 1906 and 1915 more than 42 per cent of the 45000 child deaths under the age of two were as a result of infantile diarrhoea (Copp, 1974, 93). Some of the other common nineteenth and early twentieth century diseases with well known environmental causes are, in no particular order, cholera, tuberculosis (consumption), pneumonia, and scarlet fever (Condran and Cheney, 1982, 107-118; Condran and Crimmins-Gardner, 1978, 35-44; Crimmins and Condran, 1983, 47; Richardson et al, 1901).

As Table 13 shows, the most common cause of infant death in Ottawa in 1901 was cholera. Accounting for over 14 per cent of all infant deaths in the city, it occurred almost twice as often as the next highest occurring cause. In addition to the 43 cholera deaths, were 27 deaths resulting from complications incurred by premature birth, 24 each from diarrhoea and debility and 14 each from bronchitis and tuberculosis (consumption). Twelve causes resulted in almost seven tenths of all infant deaths (Table 13). While these twelve causes were the most common killers of Ottawa's infants, many others were important too. Heart disease, consumption (tuberculosis), croup, measles, congenital malformations and complications during delivery also occurred. Interestingly, some of the most common causes of infant and

childhood death of this era were not evident in Ottawa at this time; small-pox, scarlet and typhoid fevers did not claim any infant lives, and tuberculosis claimed fewer lives than might otherwise have been expected (Condran and Cheney, 1982, 106).

Table 13 - Frequency and Percentage of Total Infant Deaths by the Most Common Causes, Ottawa, 1901

Asthenia	13	(4.3%)	Bronchitis	14	(4.6%)
Cholera	43	(14.1%)	Convulsions	14	(4.6%)
Debility	24	(7.9%)	Diarrhoea	24	(7.9%)
Enteritis	7	(2.3%)	Marasmus	11	(3.6%)
Meningitis	12	(3.9%)	Pneumonia	12	(3.9%)
Premature	27	(8.9%)	Whooping - Cough	6	(2.0%)

(Source: Compiled by the author)

In order to better assess and understand the locational and seasonal patterns and distributions of infant death in Ottawa at this time, it is necessary to be familiar with the main causes of death. Understanding the nature of the illnesses and diseases that resulted in so many infant deaths, as well as their causes is crucial to the recognition of locational and seasonal patterns of infant death. The intent here is not to delve into detailed pathophysiology, but rather to help categorize or simplify the most common causes of infant death in Ottawa in 1901. Of the twelve most common causes of infant death mentioned above, six fall into a category entitled diseases of the stomach or diarrhoeal diseases; asthenia, cholera, debility, enteritis, diarrhoea and marasmus (Dorland, 1995; Berkow, 1992; Richardson, 1901).³ The second category of diseases are linked by their association to the respiratory system. These respiratory illnesses

include bronchitis, pneumonia and whooping cough (Dorland, 1995; Berkow, 1992; Richardson, 1901). The final three diseases or illnesses that were among the twelve most prevalent in Ottawa, meningitis, convulsions and premature birth fit into neither of the above categories. Meningitis, or "brain-fever" as it was also known, was thought to be caused by complications resulting from a severe injury to the head (Richardson, 1901, 344-345). Today, meningitis is recognized as being caused by a viral/bacterial infection which affects the meninges at the base of the brain. Deaths listed as premature may have been the result of numerous congenital illnesses (Berkow, 1992, 1972-1976). Finally, convulsions is now considered a symptom of a variety of diseases and ailments, rather than a specific disease entity on its own. Any one of the previous eleven causes, or others, could have led to convulsions.

Of Ottawa's 304 infant deaths, 122 or forty per cent were the result of infantile disorders of the gastro-intestinal tract, where death was usually directly the result of dehydration caused by diarrhoea; these deaths are referred to as diarrhoeal. A loss of strength and general weakness were the typical symptoms of both asthenia and debility, which together accounted for 37 of the infant deaths (Dorland, 1995, 85 & 216; Richardson, 1901, 1407). Because these two lethargic illnesses' symptomology was characteristic of malnutrition, Richardson, in his text Medicology: Home Encyclopedia of Health, classified them as diarrhoeal diseases (Richardson, 1901, 631-647). Like asthenia and debility, marasmus is a form of malnutrition mainly due to prolonged severe caloric deficit, or starvation, and most often occurs in the first year of life (Dorland, 1995, 476). In 1901 Ottawa, marasmus was the cause of death

listed for 11 of the 304 infants. Today, marasmus is the dominant form of malnutrition in developing countries and is often associated with the early abandonment or failure of breast-feeding and with consequent infections, most notably those causing infantile gastro-enteritis (Berkow, 1992, 956). These infections often result from a lack of hygiene and are now most prevalent in the rapidly growing slums of developing countries (Berkow, 1995, 956).

Enteritis or gastro-enteritis is an illness caused by the inflammation of the small intestine (Dorland, 1995, 287). The 'spiral' organism which causes this inflammation, is still found world-wide, but the prevalence of the disease is significantly higher in populations living in unsanitary conditions (Berkow, 1992, 764). Prevalence of enteritis is also age related; infants and young children are up to five times more likely to contract enteritis than are adults (Berkow, 1992, 764). In Ottawa, seven infants died of enteritis. The gastro-enteritic illnesses discussed above, and many other intestinal diseases, usually are identified by symptoms of severe diarrhoea and vomiting. Death of infants to diarrhoeal diseases, as listed in the death registry, are symptomatic of many of these intestinal illnesses. Twenty four of Ottawa's infants died of diarrhoeal diseases. Often these diarrhoeal diseases are linked to unsanitary conditions, as seen by today's common 'travellers diarrhoea' where tourists pick up intestinal ailments from polluted water and contaminated food (Dorland, 1995, 233). Death from diarrhoeal diseases can often resemble cholera when it is associated with a collapse of the circulatory system (Dorland, 1995, 233). In 1901, Richardson found that diarrhoea was most often fatal with the very young and those not able to seek

prompt treatment (Richardson, 1901, 488). He also identified the 'social causes' of diarrhoea when he wrote,

[i]n many cases this common malady is also rather a consequence or symptom of some morbid condition rather than itself a disease. (Richardson, 1901, 486).

The final cause of death categorized here, under diarrhoeal diseases, is cholera. Cholera is an acute infection involving the entire small bowel and characterized by profuse diarrhoea, vomiting, muscular cramps, dehydration and finally circulatory collapse (Berkow, 1992, 110). It is spread by the ingestion of water or food contaminated by infected human faecal matter. Today, cholera is endemic in parts of Asia, Africa and the tropical Americas (Berkow, 1992, 110). In these endemic areas, outbreaks usually occur during warm summer months and the incidence is usually highest among the very young (Berkow, 1992, 110). Throughout the nineteenth century, cholera was endemic in most cities of Europe and North America and only began to dissipate with the introduction of clean water and effective sewage removal services in the latter half of the century (Condran and Cheney, 1982, 102; Mooney, 1994, 164).

Of the respiratory diseases that were the most prevalent in Ottawa in 1901, bronchitis was the most common. An infection of the bronchial tree of the lungs, bronchitis often develops after a common cold or other viral/bacterial infection (Dorland, 1995, 122). Other contributing factors that have been linked to bronchitis are; exposure to air pollutants, especially in close quarters such as at work or home,

and extreme chilling, fatigue and malnutrition (Berkow, 1992, 657). Whooping cough, or pertussis, is a highly communicable bacterial infection transmitted through aspiration of the pertussis bacteria, sprayed into the air by an infected person (Dorland, 1995, 625). Pertussis is found throughout the world and occurs at all ages, but over half of all cases occur in children under the age of two (Berkow, 1992, 2151). Finally, pneumonia, a killer of twelve Ottawa infants in 1901, is a broad term meaning an infection of the lung tissue. The causes of pneumonia are varied with the majority being viral or bacterial in origin.

Contingency analysis was used to determine whether the frequency of these diseases varied throughout the districts of Ottawa. In considering the twelve causes of death and the three categories of causes of death discussed above, diarrhoeal, respiratory and other, no significant difference was found between the observed and the expected distributions among the four regions of Ottawa (Table 14). At the 95 per cent confidence level the calculated chi-square value of 11.93 did not exceed the critical value of 12.59 with six degrees of freedom. Therefore, the null hypothesis that there was no significant difference between the observed and expected patterns of infant deaths among the four regions of Ottawa and three cause of death categories was accepted.⁴ In other words, in this case an association between location and type of infant death was not found.

However, since over fifty per cent (122 of 207) of all deaths from the above twelve causes are classified as diarrhoeal and almost fifty per cent (96 of 207) of these same deaths occurred in Lowertown, a second contingency analysis was warranted.

Table 14 - Observed and Expected Distributions of Three Cause of Death Categories among Four Regions of Ottawa, 1901

Observed Distribution:

Category	Lowertown	Uppertown	LeBreton	Sandy Hill	Total
Diarrhoeal	64	20	21	17	122
Respiratory	12	13	3	4	32
Other	20	16	7	10	53
Total	96	49	31	31	207

Expected Distribution:

Category	Lowertown	Uppertown	LeBreton	Sandy Hill	Total
Diarrhoeal	56.58	28.88	18.27	18.27	
Respiratory	14.84	7.58	4.79	4.79	
Other	24.58	12.55	7.94	7.94	

(Source: Compiled by the author)

Table 15 - Observed and Expected Distributions of Diarrhoeal and Other Deaths: Lowertown and the Rest of Ottawa, 1901

Observed Distribution:

Category	Lowertown	Rest of Ottawa	Total
Diarrhoeal	64	58	122
All Others	32	53	85
Total	96	111	207

Expected Distribution:

Category	Lowertown	Rest of Ottawa
Diarrhoeal	56.58	65.42
All Others	39.42	45.58

(Source: Compiled by the author)

For this purpose Lowertown was contrasted with the rest of Ottawa and diarrhoeal deaths, considered to most closely reflect poor environmental conditions, were distinguished from all other causes of death (Table 15). The resultant chi-square value of 4.42 exceeds the tabulated value of 3.84 needed to reject the null hypothesis at the 95 per cent confidence level and with one degree of freedom.⁵ Diarrhoeal diseases, those believed to be most affected by a poor environment, were found to be associated with the area, Lowertown, with the worst environmental conditions.

This above analysis used the 207 infant deaths resulting from the twelve most common causes of death. When all 304 Lowertown infant deaths, those resulting from all causes, were used instead the regional variation of diarrhoeal and non-diarrhoeal deaths re-emerges. In this case, all 304 infant deaths from the four regions of Ottawa, and the two cause of death categories, diarrhoeal and non-diarrhoeal were assessed (Table 16). Again, chi-square analysis allowed for the rejection of the null hypothesis that there was no difference in frequency between Lowertown and the other three areas with respect to the occurrence of disease, dichotomized in this way.⁶ The calculated chi-square statistic was 10.41; the critical value was 7.81 with three degrees of freedom. As with the previous case when only 207 infant deaths were considered, and Lowertown was isolated from the rest of Ottawa, contingency analysis revealed that a significant difference existed between the observed pattern and the expected pattern.⁷ In other words, as Table 17 shows, diarrhoeal diseases were more likely to be concentrated in Lowertown than were non-diarrhoeal diseases. In summary, when deaths from diarrhoeal diseases were isolated from all other causes, an association

between cause of death and location of residence within Ottawa was found.

Some of the specific causes of infant death were more markedly concentrated. For example, 63 per cent of the infant cholera deaths occurred in Lowertown (Table 18). Cholera represented twenty per cent of the total of Lowertown infant deaths, while it accounted for no more than 13 per cent of the deaths in any other region of Ottawa. Debility and asthenia reflected a similar, but less pronounced pattern of concentration in Lowertown. The other common causes of infant death such as meningitis, convulsions, bronchitis, and diarrhoea (referring here to diarrhoea as a specific cause of death not the group of diarrhoeal diseases) produced a more evenly distributed pattern among the four districts. Analytically, there were insufficient cases to perform a chi-square which requires an expected value of at least five in eighty per cent of cells (Hammond and McCullagh, 1974, 144; McGrew and Monroe, 1993, 188). However, when cholera, diarrhoea and debility and asthenia (the latter two grouped together because of their similar symptomology) were evaluated, chi-square tests revealed a distinct pattern.⁸ Cholera and the combined group of debility and asthenia each displayed a marked concentration in Lowertown, whereas diarrhoea did not. Therefore, as in previous cases, through the use of chi-square analysis an association was found between cause of death, for a few select diarrhoeal diseases, and location of residence. Table 19 shows the observed and expected numbers of deaths for each of these three causes of death. Expected values were obtained based on Lowertown's proportion of the total number of infant deaths; the number of infant deaths would reflect Lowertown's proportion of the population which was 44.7 per cent.

Table 16 - Observed and Expected Distributions of Diarrhoeal and Other Deaths: Lowertown, Uppertown, Sandy Hill, and LeBreton, 1901

Observed Distribution:

Category	Lowertown	Uppertown	LeBreton	Sandy Hill	Total
Diarrhoeal	64	20	21	17	122
All Others	72	58	29	23	182
Total	136	78	46	44	304

Expected Distribution:

Category	Lowertown	Uppertown	LeBreton	Sandy Hill
Diarrhoeal	54.58	31.30	18.46	17.66
All Others	81.42	46.70	27.54	26.34

Source: Compiled by the author)

Table 17 - Observed and Expected Distributions of Diarrhoeal and Other Deaths: Lowertown and the Rest of Ottawa, 1901

Observed Distribution:

Category	Lowertown	Rest of Ottawa	Total
Diarrhoeal	64	58	122
All Others	72	110	182
Total	136	168	304

Expected Distribution:

Category	Lowertown	Rest of Ottawa
Diarrhoeal	54.58	67.42
All Others	81.42	100.58

(Source: Compiled by the author)

Table 18 - Distribution of Specific Causes of Death Among Ottawa's Four Regions, 1901

Cause	Lowertown	Uppertown	LeBreton	Sandy Hill	Total
Asthenia	10	1	1	1	13
Bronchitis	4	4	3	3	14
Cholera	27	6	6	4	43
Convulsions	7	4	2	1	14
Debility	14	3	5	2	24
Diarrhoea	7	6	5	6	24
Enteritis	3	1	1	2	7
Marasmus	3	3	3	2	11
Meningitis	4	4	2	2	12
Pneumonia	5	6	0	1	12
Premature	10	7	3	7	27
Whooping Cough	3	3	0	0	6
Total	136	78	46	44	304

(Source: Compiled by the author)

Table 19 - Observed and Expected Distributions of Specific Causes of Death in Lowertown and the Rest of Ottawa, 1901

Cause of Death	Lowertown	Rest of Ottawa	Total
Cholera:			
Observed	27	16	43
(Expected)	(19)	(24)	
Debility and Asthenia:			
Observed	24	13	37
(Expected)	(17)	(20)	
Diarrhoea:			
Observed	7	17	24
(Expected)	(11)	(13)	

(Source: Compiled by the author)

Although some specific causes of death seem to have concentrated in particular areas of the city, and others occurred too infrequently to discern a pattern of concentration, it is clear that many causes of death did in fact concentrate in particular seasons of the year. Again, cholera provides an important example of this. The summer months of June, July and August accounted for over 95 per cent of all Cholera deaths (Table 20). The same months accounted for almost 92 per cent of the deaths from diarrhoeal diseases; the two presumably overlapping to a large extent. The next most significant concentration of deaths was from bronchitis which occurred in the months of the Spring quarter when 65 per cent of the 14 bronchitis deaths resulted. The twelve causes of death shown on Table 13 represented 207 of the 304 infant deaths studied here, and over half of these occurred in the Summer months. Spring accounted for another twenty per cent of the deaths, while Fall and Winter combined, accounted for only 28 per cent.

Although the numbers are small, seasonality clearly played a central role in mortality and particularly infant mortality. In general, it is unclear whether a significant seasonality of births existed, but there was clearly a seasonality of death, particularly in this era (Thornton and Olson, 1991, 406).⁹ The above twelve causes of death show a marked seasonal pattern and this pattern holds for all deaths combined. Of all 304 deaths, 157 or 52 per cent occurred in the three summer months. July alone accounted for 26 per cent of the total annual number of deaths. Chi-square tests at both the seasonal and monthly scales showed that a significant association existed between infant death and time of the year. Clearly, seasonal concentrations of infant

deaths existed. At the seasonal level, the calculated chi-square value of 115.92 exceeded the required critical value of 7.81, and therefore the null hypothesis that there was no significant difference between the observed and expected number of deaths in each of the four seasons was rejected.¹⁰ Similarly, at the monthly level the calculated chi-square value of 166.98 exceeded the critical chi-square value of 19.68 and therefore the null hypothesis was rejected.¹¹ In each case the expected number of deaths was assumed to be equal for each season and/or month (Tables 21 and 22).

Table 20 - Seasonality of Most Common Causes of Infant Death, Ottawa, 1901

	Winter		Spring		Summer		Fall		Total
Asthenia	1	(7.7%)	1	(7.7%)	6	(46.2%)	5	(38.5%)	13
Bronchitis	1	(7.1%)	9	(64.3%)	3	(21.4%)	1	(7.1%)	14
Cholera	0	(0.0%)	1	(2.3%)	41	(95.3%)	1	(2.3%)	43
Convulsions	4	(28.6%)	3	(21.4%)	4	(28.6%)	3	(21.4%)	14
Debility	2	(8.3%)	8	(33.3%)	8	(33.3%)	6	(25.0%)	24
Diarrhoea	0	(0.0%)	0	(0.0%)	22	(91.7%)	2	(8.3%)	24
Enteritis	0	(0.0%)	0	(0.0%)	4	(57.1%)	3	(42.9%)	7
Marasmus	2	(18.2%)	3	(27.3%)	4	(36.4%)	2	(18.2%)	11
Meningitis	4	(33.3%)	2	(16.7%)	5	(41.7%)	1	(8.3%)	12
Pneumonia	3	(25.0%)	6	(50.0%)	1	(8.3%)	2	(16.7%)	12
Premature	11	(40.7%)	7	(25.9%)	5	(18.5%)	4	(14.8%)	27
Whooping Cough	1	(16.7%)	2	(33.3%)	3	(50.0%)	0	(0.0%)	6
Total (all causes)	44	(14.5%)	55	(18.1%)	157	(51.6%)	48	(15.8%)	304

(Source: Compiled by the author)

Table 21 - Observed and Expected Numbers of Infant Deaths by Season for Ottawa, 1901

Season	Observed Number of Deaths	Expected Number of Deaths
Winter	44	76
Spring	55	76
Summer	157	76
Fall	48	76
Total	304	304

(Source: Compiled by the author)

Table 22 - Observed and Expected Numbers of Infant Deaths by Month for Ottawa, 1901

Month	Observed Number of Deaths	Month	Observed Number of Deaths
January	18	July	80
February	13	August	33
March	16	September	19
April	15	October	14
May	24	November	15
June	44	December	13

Expected Number of Deaths = 25.3 each month

Source: Compiled by the author)

Although overall levels of infant mortality within Ottawa varied widely between districts, it appears that the dominance of the summer mortality pattern was common

in all districts. In each of the four Ottawa regions, the summer months resulted in the most number of deaths (Table 23). The relative magnitude, however, was quite different. Lowertown's summer mortality period accounted for 59 per cent of its deaths, while Uppertown's peak period of deaths resulted in only 43 per cent of its total. The two newer communities (LeBreton and Sandy Hill), again had peak period values midway between the two extreme regions, each with about fifty per cent of their respective totals occurring in the summer season. Despite these differences in relative peak period concentrations of summer deaths, chi-square tests for each region show that none of the region's seasonal patterns was significantly different from the expected pattern.¹² Expected values for infant deaths were determined as a proportion of all infant deaths that occurred in each season for the city as a whole. For example, 14 per cent of all infant deaths in Ottawa occurred in the winter months, and so for each region 14 per cent of the deaths were expected to occur in the winter. Therefore, for each region the seasonal pattern of infant death was found to be similar to the pattern for the city as a whole.

Mooney found a similar pattern of seasonality in London, where each of the regions studied had similar seasonal patterns to each other and the city as a whole (Mooney, 1994, 162). Mooney goes on to suggest that the two most important components of the persistence of high urban seasonal infant mortality were milk and environmental conditions (Mooney, 1994, 165). European evidence supports the idea that breast feeding was not universal among nineteenth century mothers and that it probably had an effect on infant mortality (Woods, Watterson and Woodward, 1989).

Table 23 - Observed and Expected Numbers of Infant Deaths by Season for each of the Four Districts of Ottawa, 1901

Region	Winter	Spring	Summer	Fall	Total
Lowertown:					
Observed	14	18	79	25	136
(expected)	(19)	(24)	(70)	(22)	
Uppertown:					
Observed	18	16	34	11	78
(expected)	(11)	(14)	(41)	(13)	
LeBreton:					
Observed	7	7	23	9	46
(expected)	(7)	(8)	(24)	(7)	
Sandy Hill:					
Observed	5	14	21	4	44
(expected)	(6)	(8)	(23)	(7)	

(Source: Compiled by the author)

Whereas breast feeding confers a certain level of natural immunity on infants, the preparation of artificial milk introduced the possibility of infection which was linked to the activity of flies. By the turn of the century, these were recognized as vehicles for the transmission of human excreta to milk. As Thornton and Olson clearly point out, the inability of foundling homes to keep their residents alive supports the hypothesis that the feeding of infants with artificial milk greatly increased the incidence of diarrhoeal diseases and the seasonal effect of mortality (Thornton and Olson, 1991, 407). Obviously, since care-givers in foundling institutions could not breast feed the infant residents and the infant mortality rate at these institutions was so

high, this link is plausible.

Given the evidence above, the link between seasonal infant mortality and breast feeding practices is likely, but determining which households, which cultures and which economic classes were and were not breast feeding their infants is virtually impossible. Thornton and Olson, among others, can only make suggestions about the different breast feeding practices of French- and Anglo- speaking residents of Montreal (Thornton and Olson, 1991, 413). Although it is tempting to extrapolate from Montreal, the cultural practices of the mothers of Ottawa, as reflected by their breast feeding practices, cannot be investigated here.

The other factor that Mooney presents as important in the seasonal effect on infant mortality is environmental conditions. Arthur Newsholme, Chief Medical Officer of London between 1908 - 1919 agreed.

A dirty house and unsatisfactory methods of storage and preparation of infants' food may result from lack of training of the mother, but they are also commonly caused by the fact that her life is lived under adverse conditions, for which she is not responsible, and which can be only improved by public health measures, improved sanitation, separate water supply for each tenement, etc., etc., and by more adequate aid in the relief and prevention of poverty. (Newsholme, 1936 - Quoted in Mooney, 1994, 167).

In addition, contemporary American authors Woods, Watterson and Woodward write that,

[c]limatic conditions, especially during the third quarter of the year, interacted with poor urban sanitary environments, which resulted in high levels of diarrhoea and dysentery among infants, particularly those aged between 1 and 11 months (Woods, Watterson and Woodward, 1988, 360).

Unlike breast feeding practices, however the environmental conditions of families in

Ottawa and Lowertown can be studied.

Two further components of the seasonality and cause of death issue still need to be examined briefly. Exact figures of births in Ottawa in 1901 are not known, but 1526 children, under the age of one lived there at the time of the census in April of that year (Census of Canada, 1901, Vol IV, 8). Of these 1526 infants, slightly over half were female. As is generally the case, slightly over half (56 per cent) of Ottawa's 1901 infant deaths were males (Census of Canada, Vol IV, 8; McInnis, 1990, Plate 29). Due to the lack of birth data for Ottawa, it is impossible to determine the exact infant mortality rate, however, it is possible to develop an approximation. In addition to the 1526 infants alive in 1901, 429 infants died including the deaths of foundlings.¹³ Overall, therefore, nearly 22 per cent of all infants in Ottawa died in 1901. This proportion is slightly higher for males at 24 per cent and slightly less for females at only twenty per cent.

The final component of infant mortality to be studied here is age of death. Figures for the ages of all infant deaths in Ottawa are not known, but those for the 136 infants that died in Lowertown are. Henry suggests that 'modern' infant mortality rates in France indicate that close to seventy (68.2) per cent of all infant deaths occur in the first month (Henry, 1976, 149). These neonatal deaths are often the result of endogenous causes or, in other words, are congenital. On the other hand, deaths after the first month are more often the result of exogenous factors such as environmental conditions (Henry, 1976, 148; Ogden, 1994, 398). Only thirty per cent of all Lowertown infant deaths were neonatal, a figure which compares favourably with that

of Montreal in the mid-nineteenth century (Thornton and Olson, 1991, 407). This further supports the argument that environmental conditions had a large impact on 'turn of the century' infant mortality. Today, urban environmental conditions have been improved and the proportion of infant deaths occurring in the first month (usually congenital in nature) has reached close to seventy per cent and therefore, only 30 per cent can be classified as environmentally related (Henry, 1976, 149). In 1901 Ottawa, on the other hand, the proportions were reversed; seventy per cent of infant deaths occurred after the child reached one month of age, and therefore, the deaths were likely exacerbated by poor environmental conditions.

Physicians in Ottawa:

A 1983 thesis by McDonald reveals a great deal about physician provided health care in Ottawa. Although the objective of his thesis was to establish the forces affecting the locational decisions of doctors in Ottawa over the period 1875 - 1915, his work reveals a great deal about the inequality of care available to residents of the city. He set out to establish whether doctors chose to locate their practices based on the proximity of available patients or to maximize their economic and social position within the class hierarchy of Ottawa.

As a measure of physician provided service, McDonald determined the number of patients per doctor for each significant residential area of Ottawa for five specific time periods, 1880 through 1913 (McDonald, 1983, 144-154). Of most relevance to

this thesis is the year 1900, the closest available year for comparison. The average number of patients per physician for the city as a whole in 1900 was about 1000. Sandy Hill's ratio was about the same as the general figure (McDonald, 1983, 148). The ratio for Uppertown was close to only 500 patients per resident doctor and Lowertown, at the other extreme, had upwards of 2600 patients per doctor (McDonald, 1983, 148-154). Clearly, as McDonald found, the importance of proximity to patients did not weigh heavily on the minds of turn of the century physicians in Ottawa.

Also of importance is how McDonald, in his temporal study, shows that the actual number of physicians residing and serving the residents of Lowertown declined from a peak in 1875, and reached its lowest level in 1900, before rising again towards 1915 (McDonald, 1983, 106-114). In 1902, through the use of city directories, McDonald found only five physicians in Lowertown (McDonald, 1983, 118). In comparison to the few doctors in Lowertown, Sandy Hill had eleven, and Uppertown had over fifty (Figure 11) (McDonald, 1983, 111)¹⁴. This pattern suggests that 1901's infant mortality rate in Lowertown may actually have increased in that year because of a relative lack of resident physicians offering care. Moreover, McDonald shows that Lowertown's proportional share of physicians, throughout this time period, was low.

His study demonstrates that the Lowertown residents likely had less access to physician provided medical services compared to those residents in the rest of the city. This situation undoubtedly added to the higher infant mortality rates in Lowertown as those infants that became ill were less likely to receive adequate medical care, if any

Figure 11 - Distribution of Physicians, Ottawa, 1900

(Source: Reproduced from McDonald, 1983, 111)

care at all, when needed. Unfortunately McDonald's work does not address the quality of physician care available in the different parts of the city, only the quantity. Similarly, accessibility to services by the poor is not addressed beyond the simple geographic proximity to a doctor's clinic. Ability to pay for physician services is also not studied as a factor contributing to the lack of care provided to Lowertown residents. Nevertheless, the seasonal and locational distribution of infant deaths in the summer months and in Lowertown was most likely exacerbated by this lack of available adequate medical service.

Conclusions:

The objective of this chapter was to explore the distribution of infant mortality for the city as a whole and to discern whether that pattern matched the social landscape of Ottawa as described in Chapter Three. Indeed, the distribution of infant mortality was seen to coincide with the distributions of ethnicity, religion, language and housing types in the city of Ottawa as a whole. Lowertown, in particular, was home to both the poorest living conditions and the highest rates of infant mortality. This chapter also provided some insight into the nature of infant mortality in Ottawa. As in cities around the world in the nineteenth century, the link between Ottawa's, and particularly Lowertown's environment and specific diseases was clear. Ottawa in 1901 was most affected by mortality from environmental diseases, those resulting from poor living conditions including poor housing, water quality, sewage and malnutrition.

Specific diseases were not found to concentrate in particular areas of Ottawa, although diarrhoeal diseases, as the group most affected by environmental conditions, were found to be more prevalent in Lowertown than elsewhere in the city. Moreover, diarrhoeal and other diseases tended to concentrate in the summer season. A seasonality of disease existed for all areas of Ottawa, but was more pronounced within the category of environmental diseases and geographically in Lowertown. Possible links to the limited provision of physician services in Lowertown were also suggested.

Notes - Chapter Four

1. Chi-square statistic = 36.46. Critical value of the chi-square = 7.81 (see Hammond and McCullagh, 1974, 144 - 154 and 288); with three degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths among the four 'districts' of Ottawa and the expected pattern based on the proportion of the population. Since $36.46 > 7.81$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

2. Chi-square statistic = 43.41. Critical value of the chi-square = 12.59; with six degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths among the seven wards of Ottawa and the expected pattern based on the proportion of the population. Since $43.41 > 12.59$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

3. Of note here is that within this group of 'diarrhoeal' diseases is the specific cause of death diarrhoea (as registered in the death records). Every effort has been made to use the term diarrhoeal when referring to this group of causes and diarrhoea when referring to the specific cause of death.

4. Chi-square statistic = 11.93. Critical value of the chi-square = 12.59; with six degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths among the four 'districts' of Ottawa with respect to three cause of death categories (diarrhoeal, respiratory and other) and the expected pattern. Since $11.93 < 12.59$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

5. Chi-square statistic = 4.42. Critical value of the chi-square = 3.84; with one degree of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between Lowertown and the rest of the city with respect to the two major causes of death (Diarrhoeal and all others) and the expected pattern. Since $4.42 > 3.84$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

6. Chi-square statistic = 10.41. Critical value of the chi-square = 7.81; with three degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths among the four 'districts' of Ottawa with respect to the two major cause of death categories (Diarrhoeal and all others) and the expected pattern. Since $10.41 > 7.81$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

7. Chi-square statistic = 4.92. Critical value of the chi-square = 3.84; with one degree of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between Lowertown and the rest

of Ottawa with respect to the two major cause of death categories (Diarrhoeal and all others) and the expected pattern. Since $4.92 > 3.84$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

8.

a) Cholera:

Chi-square statistic = 6.04. Critical value of the chi-square = 3.84; with one degree of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths from cholera between Lowertown and the rest of Ottawa and the expected pattern. Since $6.04 > 3.84$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

b) Debility and Asthenia:

Chi-square statistic = 5.33. Critical value of the chi-square = 3.84; with one degree of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths from debility and asthenia between Lowertown and the rest of Ottawa and the expected pattern. Since $5.33 > 3.84$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

c) Diarrhoea:

Chi-square statistic = 2.69. Critical value of the chi-square = 3.84; with one degree of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths from diarrhoea between Lowertown and the rest of Ottawa and the expected pattern. Since $2.69 < 3.84$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

9. The literature on the seasonality of births is substantial. For a review of the major theories on this topic, especially for Canada see Trovato and Odynak, 1993. In this provocative paper they theorize that a seasonality of births in Canada, and elsewhere, does indeed exist. In Canada most births occur in the spring and early summer, followed by the peak period of births in September. They theorize that holidays (Christmas-time conceptions matched with September births) are the single most important factor in this seasonal pattern.

On a similar note, Buffone, in his recent work has shown that a seasonal pattern of marriages existed for 1871 Ontario; most ethno-religious groups had more marriages in the winter months (with the exception of December) than any other period (Buffone, 1997, 112-117). This seasonality of marriage may have caused a seasonal pattern of births, but this latter point remains to be shown.

10. Chi-square statistic = 115.92. Critical value of the chi-square = 7.81; with three degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between the four seasons and the expected pattern. Since $115.92 > 7.81$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

11. Chi-square statistic = 166.98. Critical value of the chi-square = 19.68; with eleven degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between the twelve months of the year and the expected pattern. Since $166.98 > 19.68$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

12.

a) Lowertown:

Chi-square statistic = 4.16. Critical value of the chi-square = 7.82; with three degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths by season in Lowertown and the expected pattern based on the pattern of the city as a whole. Since $4.16 < 7.82$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

b) Uppertown:

Chi-square statistic = 6.24. Critical value of the chi-square = 7.82; with three degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths by season in Uppertown and the expected pattern based on the pattern of the city as a whole. Since $6.24 < 7.82$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

c) LeBreton:

Chi-square statistic = 0.74. Critical value of the chi-square = 7.82; with three degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths by season in LeBreton and the expected pattern based on the pattern of the city as a whole. Since $0.74 < 7.82$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

d) Sandy Hill:

Chi-square statistic = 6.13. Critical value of the chi-square = 7.82; with three degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths by season in Sandy Hill and the expected pattern based on the pattern of the city as a whole. Since $6.13 < 7.82$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

13. This figure of 429 infant deaths is based on the 538 registered deaths minus the 32 untraceable deaths, the 10 deaths to families living outside of Ottawa and the 67 stillbirths.

14. Permission for the reproduction of this map was generously provided by John McDonald.

Chapter Five:

The Geographical Distribution of Infant Deaths in Lowertown, and the Social, Economic and Housing Factors Associated with Infant Death

Introduction:

Given the pattern of infant death for the city as a whole, as described in Chapter Four, it is important to examine the essential contributing factors to the infant mortality problem in Lowertown. The primary objective of this chapter is to focus on Lowertown and to examine the geographic distribution of infant deaths within the two Lowertown wards. The chapter will then examine, in some detail, the economic, social and housing factors that may, or may not, have been associated with these deaths. These factors are grouped for convenience into three broad categories; social, economic and housing. The relationship of each to the incidence of Lowertown infant mortality is studied. The objective is to determine the relationship, between infant deaths in Lowertown and factors such as income, assessed value of property, ethnicity, language, religion, literacy, house type, housing density and family size. The first part of this analysis examines the specific distribution of infant deaths in Lowertown, in order to establish if there were areas where infant deaths were especially marked.

Infant Mortality in Lowertown - 1901:

With the evidence provided by the examination of infant mortality for the city as a whole, it is useful to investigate further the nature of infant mortality in the

region with the most highly concentrated number of deaths. Questions arise around why Lowertown had a higher rate of infant mortality than elsewhere, and what factors were associated with that higher concentration. These questions, and others like them, are key to this chapter. The following discussion is divided into four sections. The first addresses the geographical distribution of Lowertown infant deaths to determine whether a spatial pattern exists in this particular area. Also, the seasonal distribution and spatial pattern of a particular set, that is, diarrhoeal deaths are examined because of an expected close relationship to environmental conditions in the broadest sense. The remaining three sections address the social, housing and economic factors that are related to the rate of infant mortality in Lowertown. The figures used in this analysis are the 136 Lowertown infant deaths and their families and the 610 households extracted from the Lowertown population in a twenty per cent stratified sampling procedure. This representative sample population is used as the base population for comparison with the 136 infant death families. The first question to be asked is similar to the question asked in the assessment of the infant deaths for the city as a whole; are the infant deaths of Lowertown distributed evenly across the landscape?

Geographical Distribution

To examine the geographical or spatial distribution of infant deaths in Lowertown, four perspectives are used. The first perspective looks at the distribution

Figure 12 - Lowertown Streets, 1901

Figure 13 - Divisions of Lowertown, 1901

at the ward level, while the second uses a more sensitive measure of distribution - the twelve census divisions. The third and fourth perspectives use the streets and block-faces, respectively, as the basic geographical entities. For each of the four perspectives, the analysis entails the examination of which, if any, region has more deaths than the others, and similarly which regions have a higher proportion of the deaths than their share of the total population would suggest. Ottawa Ward, that part of Lowertown which is north of St. Patrick Street, is larger, in terms of geographical size and population than By Ward, its more centrally located counterpart. Ottawa Ward, in 1901, was 228 acres in size or slightly over half the size of Lowertown. It was home to 9162 people, or 54 per cent of the Lowertown population. Naturally, one would expect therefore, that based on both population and acreage, Ottawa Ward would have had just over half the total number of infant deaths. In fact, Ottawa Ward was slightly over-represented; it had more deaths than would otherwise be expected (Figure 14).

At the divisional level it becomes even more clear that the infant deaths were not evenly distributed across Lowertown. Within the twelve divisions, the number of infant deaths ranges from a high of 27 in division ten, to a low of 3 in division one, the area encompassing the Byward Market. Three of the four divisions with the highest number of infant deaths are in Ottawa Ward; division ten with 27 deaths, division seven with 14 deaths, and division twelve with 13 deaths. The second highest concentration of infant deaths in Lowertown is in By Ward, with division five having 19 deaths in total. However, each of these four divisions with high numbers of infant

Figure 14 - Infant Deaths, Lowertown, 1901

deaths also has fairly high population levels. For the most part, however, the high number of infant deaths in each division is not necessarily reflective of the larger population of that division. For example, based on the divisional population it is possible to estimate a figure for the number of 'expected' infant deaths (Table 24).

Table 24 - Infant Deaths, Population and Expected Infant Deaths by Division, Lowertown, 1901

Division	Deaths	Percent of Total Deaths	Population	Percent of Total Population	Expected Deaths
By Ward					
Division 1	3	2.2	694	4.1	6
Division 2	11	8.0	868	5.2	7
Division 3	7	5.2	1810	10.8	15
Division 4	10	7.4	997	5.9	8
Division 5	19	14.0	1699	10.1	14
Division 6	9	6.6	1633	9.7	13
Ottawa Ward					
Division 7	14	10.3	1471	8.7	12
Division 8	11	8.0	1760	10.4	14
Division 9	6	4.4	1772	10.5	14
Division 10	27	19.9	1421	8.4	11
Division 11	6	4.4	1019	6.0	8
Division 12	13	9.6	1719	10.2	14
Total	136		16863		136

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

Clearly, a very high concentration of infant deaths occurred in Ottawa Ward's division 10. With 27 infant deaths and a population that projects to having only 11

deaths, this division is highly over-represented in this category. By Ward's division five had 5 more deaths than expected, and By Ward's division two had 4 more. At the other extreme, both divisions three and nine had 8 fewer infant deaths than otherwise might have been expected. Results of a chi-square test showed that the observed distribution of infant deaths was significantly different from the expected distribution, which means that a differential pattern of infant death existed.¹ In other words, particular divisions, and thus the communities living there, experienced disproportionately higher levels of infant mortality than others, and so, by extension, infant death was clearly found to be associated with the location of a family's residence in Lowertown.

At the street level, statistical relationships between infant deaths and the resident population are difficult to ascertain for several reasons, although some useful information can still be garnered from the street level analysis. Streets have different functions. Some streets are strictly commercial in nature and thus have little relation to infant mortality, while other streets are entirely residential and still others have dual commercial and residential functions. The impact of each type of street on the social environment is different. Also, each street is of a different size, or length, and so cannot be compared equally to others. Similarly, some of the longer streets connect or even bisect several different local communities and so it is difficult to categorize the whole street as being 'healthy' or 'unhealthy'. To solve each of these problems, the best method is not to look at the different mortality rates of each street, but rather to study each block-face. Both Thornton and Olson's study on Montreal and Smith and

Frost's study of Adelaide use this procedure (Thornton and Olson, 1991, 403; Smith and Frost, 1994, 265). This method of analysis will be discussed shortly, but first, some conclusions can still be drawn from the street level analysis despite the drawbacks discussed above.

Several important streets in Lowertown, mainly concentrated towards the central commercial district in the southwest of town, had higher concentrations of infant death than others. Most of these streets ran east-west from Sussex in the west to either just east of King or the Rideau River in the east. The most representative examples of these streets are Clarence (9 deaths), St. Patrick (24 deaths), Church (12 deaths), St. Andrew (13 deaths) and Water (15 deaths). Each street begins at Sussex in the west, has a short commercial or institutional component to its land-use, and then becomes strictly residential in nature (City Directory, 1901, 60-62; 119-121; 59-60; 117-119; 135-136). The longest of these six streets Clarence, St. Patrick and St. Andrew all stretch completely across Lowertown and eventually end when they meet the Rideau River in the east.

Perpendicular to these east-west streets are four major streets (Sussex, Dalhousie, Cumberland and King) which run from Rideau Street in the south, northwards to the Ottawa River or the confluence of the Ottawa and Rideau Rivers. Contrary to the high numbers of deaths on each of the major east-west streets of Lowertown, these major north-south streets have relatively few infant deaths with only between four and six deaths each. Much of this can be explained by the highly commercial nature of each of these streets, particularly towards the south-end, and

therefore the streets had small resident populations (City Directory, 1901, 130-131; 68-70; 67-68; 87-89). The shorter length of many of the other streets in Lowertown such as Friel, Augusta, Bolton and Botelier, among others, likely explains the relatively few absolute numbers of deaths located on them.

Based on the twenty per cent sample of the Lowertown population it was possible to determine an estimate of the number of houses and people living on each street. For example, the twenty per cent sample consisted of twenty households on Sussex with an average household size of 6.15 persons or a total of 123 people. Therefore, the total real world population of Sussex Street was expected to be 615 people, and one hundred households. Based on this estimation, it was again possible to predict an 'expected' number of infant deaths per street. The expected number of infant deaths was determined through the proportion of the total Lowertown population living on that street; if ten per cent of the population lived on a street, ten per cent of the infant deaths could be expected to occur there too. Perhaps the most interesting street, in terms of the number of deaths in relation to population is Water Street. With 15 infant deaths, and a population that resulted in only 7 expected deaths, Water Street seems to have been significantly over-represented in infant mortality. Other streets in this over-represented category are St. Patrick and St. Andrew, with five and three more observed deaths than expected, respectively. Only Clarence, with twelve expected and nine observed infant deaths is in the category of significantly under-represented. The above results, suggest that the streets with more deaths than expected were perhaps home to particularly poor social and environmental conditions

that influenced the overall "health" of the street.

However, what is lacking from this above analysis is any sense of whether the infant deaths on the street were spread evenly or were clustered on one or several blocks. In an effort to assess this possible pattern, the block-face or street frontage analysis was undertaken. Each street was divided into the appropriate number of block-faces through the use of city directories. Following this, each of the over 600 sample households and 136 infant death households were located onto their appropriate block-faces. As expected, the longer streets had greater numbers of block-faces than did the shorter streets, but this process allowed for a more sensitive measure of conditions on each street, or block-face. As discussed in the methodology section of Chapter Three, not all of the potentially habitable block-faces were actually being lived on due to various non-residential land-uses.

In total, out of the 305 block-faces determined to be habitable, 79 of them did not have a household from the twenty per cent sample (Figure 9). Due to commercial, industrial, institutional and recreational land uses as well as extremely low density settlement as seen through the occupation of land by estates and 'private grounds' these 79 block-faces were excluded from further study because of the lack of comparative residential data (City Directory, 1901, 50-141). For Lowertown as a whole, 26 per cent of the available block-faces were excluded because of this lack of data from the sample. However, the distribution of streets that had substantial numbers of block-faces excluded reveals an interesting pattern. In total, 19 of the 39 streets in Lowertown had over twenty per cent of the available block-faces excluded.

Of these, ten consisted of less than four blocks each, thus many of them were only missing one block. In addition, many of them were located on the outskirts of town; such as Heney, Rose, Papineau, and Notre Dame in the north-east, and Metcalfe Square, Cathcart Square, and McKay in the north. Along with being located on the periphery of Lowertown, the block-faces that were excluded were often used by land owners with large estates and were excluded by chance in the sampling process (City Directory, 1901, 50-141). Of the remaining nine streets with more than twenty per cent of the block-faces excluded, Cumberland, Dalhousie, King, Sussex and York all represent streets with significant amounts of commercial, industrial and institutional land uses (City Directory, 1901, 67-68; 68-69; 87-89; 130-131; 140-141).

For the remaining twenty streets in Lowertown with at least 80 per cent of the blocks included for further study, it is clear, and fortunate, that the streets with the highest numbers of deaths are in fact included; St. Patrick, St. Andrew, Church, Water, Clarence, and Murray. So as expected, the streets with mainly residential land use had a higher number of absolute deaths than did streets with diverse land uses.

In order to evaluate the distribution of deaths along a street, a measure of death-free blocks is used. For each street, the percentage of block-faces with residential settlement that had deaths located on them was calculated. On average, for those streets with at least one death, 70 per cent of block-faces had a death. For example, Murray Street has 14 block-faces, and recorded six infant deaths. However, these six infant deaths were found on only four block-faces, and so the percentage of death-free block-faces is 10 divided by 14, or 71.4 per cent. The streets with a low

percentage of death-free block-faces are St. Patrick (48 per cent), Church (33 per cent), St. Andrew (57 per cent), Water (33 per cent) and Cathcart (60 per cent). Interestingly, most of the streets with low percentages of death-free block-faces coincide with those streets with a high absolute number of infant deaths. The east-west streets with high numbers of infant deaths represent a thick band across the middle of Lowertown, and these same streets, with the exception of Clarence, have low death-free percentages. Again, the major north-south streets of Sussex, Dalhousie, Cumberland and King all had high proportions of their block-faces being death-free.

Another measure used to determine locations of particularly 'bad' block-faces is the deaths per block-face, or better still the deaths per 'death' block-faces. While the above measure helped to highlight which streets had a high proportion of the deaths occurring on a few select block-faces, it did not show how significant that 'clustering' was. For example, for a street with one death and ten block-faces the 'death-free' statistic would show that 90 per cent of the block-faces were death-free. On the other hand, a similar sized street, again with ten block-faces that had five infant deaths on one block would also appear as 90 per cent death-free. Obviously these two hypothetical streets are not equally 'healthy'. To avoid this problem, the death per 'death' block-face measure was introduced. For all of the streets in Lowertown that had at least one death, the average number of infant deaths per block was 0.55. For those block-faces with an actual death, the average was 1.33 deaths per block-face.

Of the 39 streets in Lowertown, 28 had at least one infant death. These streets account for most (194 out of 226) of the block-faces with sample households on them. Of these 28 streets, 17 of them averaged only one death per 'death' block-face. These 17 streets accounted for 36 of the 86 'death' block-faces and 137 of the 194 occupied block-faces. What this group accounts for are the streets with relatively spread out cases of infant deaths. At the other extreme, there are only six streets that averaged greater than two deaths per 'death' block-face. Included in this latter group of streets are Church (2.00 deaths/'death' block-face), St. Andrew (2.17) and Water (2.50). Also among this latter group are three streets with high concentrations of deaths, as measured by the deaths per 'death' block-face statistic, but only a small absolute number of deaths and block-faces; Friel (4 deaths and 2 block-faces), Martineau (2 deaths and 1 block-face) and finally York (6 deaths and 3 block-faces). The remaining five streets, with infant deaths, have ratios between one and two. Three of the streets in Lowertown (St. Patrick, Clarence and Cathcart) that have received more attention so far because of their high numbers of infant deaths all had moderate degrees of infant death concentration. The streets of this latter group show some concentration on particular blocks, but overall their deaths are well spread out.

In Adelaide, Smith and Frost identified several streets with two or more infant deaths and labelled these as 'black spots' (Smith and Frost, 1994, 265). Much of their reasoning behind labelling streets with only two deaths as black spots was because these deaths represented a quarter, or more, of the local births on the street; an infant mortality rate of 250 per 1000 live births (Smith and Frost, 1994, 265). Figures for

Lowertown births are not available, but clearly some of the streets and block-faces of Lowertown can be accorded the same 'black-spot' label as those in Adelaide. Streets such as St. Patrick, Water, St. Andrew, Church, Clarence and Cathcart all fall into this category.

In addition, ten specific block-faces have three or more deaths and are considered 'black spots' as well (Table 25). Eight of these ten 'black spot' block-faces are found on the above mentioned streets. The most obvious pattern from this 'black spot' analysis is the moderate clustering of deaths on Water Street near King. On both the north and south sides of Water, to both the east and west of King are 'black spot' block-faces. These four block-faces alone account for 13 infant deaths. Another 'black spot' lies two streets to the south of Water on the north-side of Church to the west of King. Similarly, another cluster occurs on the north-side of St. Andrew only two blocks east of King. The other 'black spots' are more spatially differentiated from each other, but caution should be taken when assessing the Sussex and Friel 'black spots' because of the much larger sized block-faces on which they occur.

For Adelaide, Smith and Frost often found that the streets close to the 'black spots' had remarkably low infant mortality rates, despite similar housing type and population density (Smith and Frost, 1994, 267). Physically, these 'black spot' streets were very similar to their neighbouring streets. They also found that from one year to the next, these 'black spots' actually moved, reflecting both a high transiency rate of the population and perhaps, the insignificance of the immediate physical surroundings

Table 25 - 'Black Spot' Block-Faces and their Locations Within Lowertown, 1901

Street	Side	Between		
Church	North	Cumberland	&	King
Friel	West	Clarence	&	Rideau Street
St. Andrew	North	Sussex	&	Dalhousie
St. Andrew	North	Rose	&	Rideau River
St. Patrick	South	Friel	&	Chapel
Sussex	West	St. Patrick	&	Rideau Street
Water	North	Cumberland	&	King
Water	North	King	&	Rideau River
Water	South	Cumberland	&	King
Water	South	King	&	Rose

(Source: Compiled by the author)

to high infant mortality levels (Smith and Frost, 1994, 266 and 268). Since in any street, two houses may have been physically identical on the outside and exposed to the same general hazards of living in that neighbourhood, it is likely that the unique combination of attributes held by each household within the home was responsible for creating differing degrees of risk for infant death. Smith and Frost ultimately believe that it is more helpful to look beyond the quality of the physical environment around the household and instead to examine the conditions of living within specific homes.

They write,

[i]f a family were vulnerable to infant death this could not be changed simply by moving to a house in a low-density suburb. High infant mortality was generally the lot of people who were poor, and not necessarily that of people who lived in a high-density setting. The key was the poverty which forced people to live in low-rent areas, combined with immeasurable influences such as women's education, family size and the household disease environment. (Smith and Frost, 1994, 271).

The implications of these findings to this study of Lowertown are clear. There is really only a tenuous relationship between infant death and particular locales in Lowertown and therefore a determination of causation of death prescribed only by location, such as due to topography, sewer and water service provision cannot be made given the results obtained in this study. Similar to Smith and Frost's study of Adelaide, the chances of Lowertown infants dying likely had more to do with factors inside the home than with simple geographic location within the area.

A final 'level' of analysis is the block. As opposed to the block-face analysis which considers only one side of a block, the block analysis examines all sides and considers the block as one entity. Figure 15 shows the number of infant deaths per block, ranging from zero to six deaths per block. The blocks already mentioned on Water Street to the west of King Edward, along with the block between Nelson and Friel and south of Clarence Street are the only blocks with six deaths each. Many of the patterns revealed by this analysis confirm those discussed earlier. It is important to acknowledge that to date it is unclear whether the locational effects of poor living conditions are exacerbated by poor living conditions of other dwellings on the same block, as is being assumed in this analysis, or by the dwellings across the street, as assumed in the street and block-face analyses. However, it is important to note that it is still not clear whether the presence of other poor quality dwellings has any measurable effect at all on the healthful-ness of a home.

To this point, the distribution of infant deaths has been examined at the ward, division, street, block and block-face levels. A final perspective simply focusses on

Figure 15 - Infant Deaths per Block, Lowertown, 1901

the relationship, through distance, between each infant death. In a Nearest Neighbour Analysis, the distance from each point, in this case an infant death, to its nearest neighbour is measured. The resultant statistic is the mean nearest neighbour distance, and this can be compared to one of three expected distributions; random, perfectly clustered and perfectly dispersed indicated by nearest neighbour (R) values of 1.0, 0.0 and 2.149 respectively. For the cases of Lowertown infant deaths, the distribution of points is nearly randomly distributed as indicated by a calculated value of R of 0.8850. However, a Z-test reveals this value to be significantly different, at the 95 per cent confidence level, from a random distribution and therefore a tendency towards clustering may exist, particularly on the few key blocks discussed above.² This result confirms much of what has been presented in this section. Some divisions, streets and block-faces were more likely to have infant deaths than others. However, several caveats must be taken before accepting a result from a Nearest Neighbour Analysis; clustering of points only requires, at the extreme, several 'pairs' of observations not a high concentration of observations, sub-patterns of clustering and dispersion within a given area may cancel each other out, and finally the boundary may separate several clustered observations (Hammond and McCullagh, 1986, 270-281; Johnston, 1980, 219-221; McGrew and Monroe, 1993, 214-222). Although Nearest Neighbour Analysis revealed a non-randomly generated moderately clustered pattern, it still remains unclear whether particular locations were prone to higher rates of infant death than others due to specific 'outbreaks' of disease or particularly adverse social and environmental conditions.

At the city-wide perspective it was found that diarrhoeal deaths were more prevalent in Lowertown than the rest of the city. Clearly, marked concentrations of diarrhoeal or environmentally related deaths existed at this macro-scale. Since diarrhoeal deaths are assumed to be closely related to the poorest environmental conditions for the city as a whole, then the same pattern may also be expected for Lowertown itself. Nearest Neighbour Analysis revealed a moderate clustering pattern of diarrhoeal deaths in Lowertown as indicated by a calculated value of R of 0.7372. Although these diarrhoeal deaths do not appear to be strongly clustered (the value of R is much closer to one than zero), they are more concentrated than the non-diarrhoeal deaths which were, for the most part, randomly distributed as indicated by a calculated value of R of 1.0103.³ Therefore, as expected, the diarrhoeal deaths displayed a more clustered spatial pattern than the non-diarrhoeal ones, perhaps indicating that the living conditions in the area in which these infants lived were somehow worse than for those that died of non-diarrhoeal causes.

However, as Figure 16 shows, this clustering of diarrhoeal deaths is only moderate at best; the overall spatial distribution of diarrhoeal deaths does not appear to be concentrated. Perhaps the effect of a few small 'pairs' of deaths is creating the statistical illusion of clustering. This result highlights a weakness in the use of Nearest Neighbour Analysis in this instance. Moreover, infant deaths that may display a non-clustered spatial pattern cannot be detected by this technique. In other words, infants that died from diarrhoeal diseases may have been affected more by proximity to polluted water sources, sewage outlets and privy pits than by their proximity to

other infants infected with diarrhoeal diseases. These exogenous locational factors can create spatial patterns which are non-clustered in nature that cannot be detected through a Nearest Neighbour Analysis. However, explanations for such non-clustered patterns of diarrhoeal deaths, if they existed, are not examined in this thesis as a more thorough investigation of the specific causes of these diarrhoeal deaths and any direct link to specific polluted environmental conditions would be required.

Of the specific diarrhoeal deaths, none showed an expected pattern of clustering in particular locations. In fact, cholera, with a long history of known association with clustering around infected water sources and privy pits, displayed an almost perfectly random distribution.⁴ Each of the other three types of diarrhoeal diseases (diarrhoea, debility and asthenia, and other diarrhoeal) displayed a more strongly clustered pattern than did cholera, but none was overly marked.⁵ As expected, taken as a whole the diarrhoeal deaths were more clustered than the non-diarrhoeal ones, but individually none of the specific diarrhoeal deaths were markedly concentrated. Figure 16 shows the spatial distribution of each of the four types of diarrhoeal deaths in Lowertown and clearly any clustering of these specific causes of death is minimal at best. In summary, with only a moderate pattern of spatial clustering of diarrhoeal deaths in Lowertown it is reasonable to conclude that perhaps all of Lowertown had relatively equal environmental conditions. In other words, perhaps all of Lowertown was equally unhealthy, and so it is possible that the conditions within the individual homes were more important than the location within the region.

Figure 16 - Infant Deaths from Diarrhoeal Disease, Lowertown, 1901

Similarly, Figure 17 shows the 136 Lowertown infant deaths by season.

Despite the overwhelming proportion of deaths that occurred in the summer months, no easily discernible spatial pattern exists for these deaths. Again, if the summer deaths are the most influenced by poor environmental conditions it is assumed that the process of mapping would identify the locations of the worst environmental conditions in Lowertown and clearly this has not happened. By extension, the worst areas of Lowertown, in theory, should have appeared with strong concentrations of summer deaths. Since no such areas appeared, it again seems probable that most of Lowertown was influenced by the same environmental conditions and that the conditions within the homes may have been more important than location within Lowertown.

Although death appears to have uniformly affected all parts of Lowertown, there were some particular locations that had more deaths than others. This is a significant result. It seems, however, that the location of residence plays only a small role in the overall infant mortality equation in Lowertown. In other words, families living in certain locations had only slightly higher chances, *ceteris paribus*, of having an infant die. Still to be determined, however, are any factors that could produce these higher rates of infant mortality, such as, poor water quality, privy pits, a nearby slaughterhouse, or stagnant water. On the other hand, it is possible that other influences, like those described for Adelaide, were more common in these locations, for example poorer quality houses, lower income families with less access to good, nutritional food, safe housing and clean clothes. So, although location within the city,

Figure 17 - Seasonality of Infant Deaths, Lowertown, 1901

and Lowertown, did seem to make a small difference in the chances of an infant family member dying, it is still not clear whether something inherent about that location was the problem, or whether it was a factor internal to the home such as income, literacy or crowding. It seems likely, therefore, based on the relatively weak clustering statistic, and the lack of any clustering of diarrhoeal or summer deaths that location is less important to the occurrence of infant deaths at the micro-scale (Lowertown) than the macro-scale (Ottawa as a whole). Perhaps, at this finer perspective, the social, economic and housing factors that exist within the individual homes is more important than the location of the dwelling. These social, housing and economic factors are addressed in the following sections.

Social Factors

Four primary variables, each related to the social makeup of the families of Lowertown are included here. These are ethnicity, or the ancestral origin of the parents of the children that died, the religious affiliation of the family, the language most often spoken at home, and literacy. In addition to comparisons of these variables for the parents with infant deaths with the parents without deaths, comparisons will also be made between parents of the same family, to see if significant differences exist. The objective here is to show which, if any, of the above variables or social factors are related to the incidence of infant death in Lowertown.

Throughout the nineteenth, and well into the twentieth century, Quebec had

Canada's highest rates of infant mortality; principally French Canadian cities had exceedingly high infant mortality rates. Quebec's provincial infant mortality rate in 1891 was 175 per thousand, and New Brunswick's was the next highest at about 135 (McInnis, 1990, Plate 29). McInnis shows that by 1931, Quebec still had the highest provincial infant mortality rate. At 110 in 1931, and the only province still over 100 infant deaths per 1000 live births, Quebec's infant mortality rate remained stubbornly high (McInnis, 1990, Plate 29). His claims that the persistently high rates of infant mortality, particularly in Quebec, reflected a "turning away from breast feeding to alternate forms of nourishing infants" (McInnis, 1990, Plate 29) is confirmed by Thornton and Olson and their study of mid-nineteenth century Montreal (1994, 413). In the late nineteenth century, both Montreal and Quebec City had infant mortality rates over 275, and Trois-Rivières was well over 200 (McInnis, 1990, Plate 29). Of all the large, primarily Anglo Canadian cities, only Toronto's infant mortality rate approximated 200 deaths per 1000 live births in 1891.

Since Lowertown has been shown to be a largely French Canadian community, and as the region with the highest number and proportion of infant deaths in Ottawa, it is perhaps not surprising that ethnicity has been associated with the incidence of infant deaths. Similar patterns have been seen elsewhere. Copp found significantly higher mortality rates, particularly of infants, for French Canadians living in turn of the century Montreal (Copp, 1974, 95). Thornton and Olson also found that the French Canadian community in mid-nineteenth century Montreal had a substantially higher infant mortality rate than either the Protestant or Irish Catholic communities in the city

(Thornton and Olson, 1994, 402). Similarly, French Canadians living in rural Lowell, Massachusetts in 1870 suffered from the worst standard of living and highest mortality rates of any ethnic community living there at that time (Early, 1982, 187).

In Ottawa's Lowertown, approximately seventy per cent of mothers and fathers were of French ancestry. Despite this, 116, or 85 per cent of the infant deaths in Lowertown were to paternally French families, and 83 per cent to French mothers. The only other ancestral origin to makeup more than ten percent of the overall population was Irish, with close to 15 per cent. However, the Irish fathers only incurred 10 infant deaths, or half as many as would otherwise be expected. Despite the small numbers of families, the other 'major' ethnic communities in Lowertown displayed a similar pattern to the Irish with fewer infant deaths than expected. Results of chi-square tests for the ethnicities of both mothers and fathers of infants that died show that ethnicity was strongly associated with infant death at the 95 per cent confidence level (Tables 26 & 27). For both fathers and mothers, parents with French ancestry had higher than expected mortality rates, while parents of Irish, English, Scottish or any other origin, had fewer deaths than expected (Figure 18).⁶

Religion too, had a significant association with infant death in Lowertown in 1901. Slightly over 85 per cent of all fathers and mothers belonged to the Roman Catholic churches of Lowertown. All but nine of the 136 infants who had died were of Catholic parents; that translates to nearly 94 per cent of all infant deaths (Table 28). Anglican fathers were the only other group to have more than two; they had five deaths. Given that nearly 95 per cent of the deaths have already been accounted for

Table 26 - Observed and Expected Number of Infant Deaths for the Four Primary Ethnicities of Fathers in Lowertown, 1901

	French	Irish	English	Scottish	Other
Observed	116	10	8	0	2
Expected	96	20	9	5	6

Expected Deaths determined by the proportion of fathers in Lowertown in each ethnic group.

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

Table 27 - Observed and Expected Number of Infant Deaths for the Four Primary Ethnicities of Mothers in Lowertown, 1901

	French	Irish	English	Scottish	Other
Observed	113	9	6	2	6
Expected	95	23	8	4	6

Expected Deaths determined by the proportion of mothers in Lowertown in each ethnic group.

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

by the Roman Catholic community, the fact that these five deaths to Anglican fathers were fewer than expected based on their proportional representation in the Lowertown population overall is important (Table 29). This Anglican under-representation in terms of total population highlights a pattern followed by the Presbyterian, Methodist and Jewish communities. Again, chi-square tests show at the 95 per cent confidence level that for both fathers and mothers the religious affiliation was associated with infant mortality. In both cases the calculated chi-square value was 7.09 and exceeded

Figure 18 - Infant Deaths by Ancestral Origin of Family, Lowertown, 1901

Table 28 - Religion and Ancestral Origin of Fathers of Lowertown Infant Deaths, 1901

	French	Irish	British (Non-Irish)	All Others	Total
Roman Catholic	116	10	1	0	127
Anglican	0	0	5	0	5
All Others	0	0	2	2	4
Total	116	10	8	2	136

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

the critical value of 3.81 with one degree of freedom at the 95 per cent confidence level.⁷

A significant association between mother tongue, or the language most often spoken at home, and infant mortality suggests that a pattern between ethnicity, religion and language developed, particularly in Lowertown. Table 30, in conjunction with Table 29, shows this relationship. The same pattern, as displayed in these two tables holds for mothers as well as for fathers. Clearly, the 'typical' parent of an infant in Lowertown that died was of French ancestral origin, Roman Catholic and French-speaking. Evidently inter-ethnic, inter-linguistic, and inter-religious marriages were rare in Ottawa since in almost every case in the sample population of Lowertown and in the families of infant deaths, the parents, when both were living, were of the same ethnic origin, linguistic background and religious affiliation. Similarly, marriages across linguistic and religious barriers in 1859 Montreal and 1871 Ontario were also very rare (Buffone, 1997; Thornton and Olson, 1994, 403).

Table 29 - Observed and Expected Number of Infant Deaths for Catholic and non-Catholic Fathers and Mothers in Lowertown, 1901

Fathers:

Religious Affiliation	Observed Deaths	Expected Deaths
Roman Catholic	127	116
Non-Catholic	9	20

Mothers:

Religious Affiliation	Observed Deaths	Expected Deaths
Roman Catholic	127	116
Non-Catholic	9	20

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

Clearly then, religion and language are strongly associated with ethnicity; religion and language spoken are indelibly connected to ancestral origins. Tables 29 and 30 demonstrate this. All 116 families with infant deaths in Lowertown that had French ancestry were Catholic and spoke French. Similarly, all of the Lowertown Irish with infant deaths were Catholic and all but one spoke English. Interestingly,

Table 30 - Mother Tongue and Ethnicity of Fathers of Lowertown Infant Deaths, 1901

	French	Irish	British (Non-Irish)	All Others	Total
French - Speaking	116	1	0	0	117
English - Speaking	0	9	8	0	17
German - Speaking	0	0	0	2	2
Total	116	10	8	2	136

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

the published census figures suggest that the Irish of Uppertown, unlike those in Lowertown, were largely Protestant. Not surprisingly, given the amalgamation of Welsh, Scottish and English parents into one category, 'British', the religious affiliations of this group were not as uniform or consistent in marriage as the Irish and French.

The evidence so far is clear. A strong link between infant mortality and ethnicity, religion, and language has been found. And since each of these three social factors are linked, they act as one inter-dependent factor. The ethnicity, and/or religion, and/or language of a family has a bearing on the likelihood of that family having an infant death. In each case, the French-speaking family, the family with French ancestral origins, and the family belonging to the Catholic church were more likely to have an infant death than their numbers warrant. However, some ethnicities, religions and linguistic backgrounds too, decrease the likelihood of having an infant death. English-speaking Lowertowners, those of Irish and British ancestry, and the Protestants all have lower frequencies of infant mortality than their numbers warrant.

It has already been shown clearly, and accepted, that ethnicity, religion and language were strongly associated with infant death. If it is assumed, as it is here, that being of French ancestry, and/or French-speaking, and/or Roman Catholic does not increase the chances of having an infant death through inferior genetic make-up, then the question remains, what is it about being French or Catholic that makes individuals more likely to have a child die? There are several obvious possible explanations. The location of residence within the city is one of many possible

factors, as are the economic standard of living and the housing conditions of these French Catholic families. Each of these factors will be explored, in relation to ethnicity and infant mortality.

Thornton and Olson suggest that the different infant mortality rates experienced by the three different cultural groups in Montreal is a reflection of different breast feeding practices among the French and Anglo populations (Thornton and Olson, 1994, 413). Copp found that the practice by often impoverished immigrant Jewish mothers of breast feeding their infants for considerably longer than other mothers may have contributed to their higher infant survival rate (Copp, 1974, 96). Data on breast feeding practices of mothers in Ottawa or Lowertown does not exist, but it seems likely that similar results would be found for this area as well.

Literacy is another social factor that relates to infant mortality. At the turn of the century, The Children's Bureau of the United States Department of Labour identified five key components of what they defined as a "safety zone" that would, they contended, lower the incidence of infant mortality in the United States (Copp, 1974, 93). The fourth component of this safety zone stipulated that, for the health of the infant, it was imperative that both the father and mother be literate (Copp, 1975, 95). The other four components encouraged the fathers to earn a decent living, mothers to not work immediately before or after birth, and finally, that families ensure that proper housing and maternal care be provided.

Chi-square tests for literacy in Lowertown show no significant difference between the observed pattern of infant mortality and the expected pattern in relation to

literate and illiterate parents (Table 31). Calculated chi-square values were 2.43 (fathers) and 0.58 (mothers) both of which were less than the required value of 5.99 for two degrees of freedom at the 95 per cent confidence level.⁸ Therefore, the hypothesis that levels of literacy had no association with infant mortality rates must be accepted. From this it might appear that literacy, and its converse illiteracy, played no part in the infant mortality problem. However, at this point, such a conclusion might be premature since the illiteracy rate was different among each of the primary ethnic and religious groups.

Table 31 - Observed and Expected Number of Infant Deaths by Level of Literacy, Lowertown, 1901

Level of Literacy	Fathers		Mothers	
	Observed	Expected	Observed	Expected
Neither read nor write	33	26	29	26
Read and/or write (not both)	4	5	4	5
Read and write	99	105	103	105

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

Lower levels of literacy among particular ethnic groups may increase the likelihood of infant mortality. Unlike the breast feeding practices of the different cultural groups of Lowertown, it is possible to assess the different literacy rates of Lowertown parents. Nineteen per cent of the Lowertown parents, mothers and father alike, were illiterate. However, this was not common in each ethnic group. More French-speaking parents were illiterate than were parents of other ethnicities. Nearly 23 per cent of French parents were illiterate, while only 14 per cent of Irish parents, 13 per cent of English parents and 17 per cent of all other parents were unable to read

and write. Barriers to education in their native tongue may account for the higher rates of illiteracy among French Canadian families.

Of more relevance, however, is the percentage of all illiterate parents that represent each of the main ethnicities. Eighty per cent of all illiterate fathers and mothers were of French ancestry and 11 per cent were of Irish descent. It is expected, therefore, that of all the infant deaths with illiterate parents, approximately eighty per cent would be of French descent. In fact, all 29 of the infant deaths with an illiterate mother were of French descent, and all but one of the 33 deaths with an illiterate father were similarly of French ancestry. Thus, French ethnicity is clearly over-represented in the illiteracy of parents with infant deaths. In other words, based on the proportion of the total illiterate population the families of French ethnicity are clearly over-represented.

Based on the above chi-square test, however, it appears that literacy does not have a direct influence on the likelihood of an infant death occurring to a family in the same way that ethnicity, religion and language do. In their extensive study on infant mortality patterns in England, Woods, Watterson and Woodward, found that, among other factors, "there is good supporting evidence for the argument that advances in women's education (the decline in women's illiteracy) would have had both direct and indirect influences on the decline of infant mortality" (Woods, Watterson and Woodward, 1989, 128). Therefore, while literacy seems to be not statistically different for parents with infant deaths than for parents without infant deaths, this conclusion appears to be counter-intuitive. As Woods, Watterson and Woodward

point out, it seems probable that literacy would be related to infant mortality, but in this case of Lowertown the data did not support this pattern.

The question that still remains, however, is was there an association between the geography of ethnicity and the geography of infant death. Interestingly, there does not appear to be a connection between the two. The four divisions with the highest percentages of the total number of infant deaths; divisions five, seven, ten and twelve have the following proportions of their local populations being of French ancestry, 69.6 per cent, 89.1 per cent, 90.0 per cent, and 43.3 per cent respectively.

Obviously, no clearly identifiable spatial pattern of French residents exists in these divisions. However, Ottawa Ward's divisions that have the highest levels of infant mortality (seven and ten) also had the two highest concentrations of French population of all divisions. Chi-square analysis of the observed and expected distributions of infant deaths to French parents shows that there is no significant association between the geography of ethnicity and the geography of infant death - other ethnicities were excluded because of too few observations to meet the contingency analysis requirements. Table 32 shows the observed and expected number of infant deaths to French parents in each of the twelve Lowertown divisions. Expected values were determined by multiplying each division's deaths by .708 since 70.8 per cent of all Lowertown parents were French. Therefore, it is reasonable to expect that 70.8 per cent of all deaths would be to French parents in each division. A chi-square calculated value of 7.93 was obtained and since it does not exceed the chi-square critical value of 19.68 for eleven degrees of freedom at the 95 per cent confidence

Table 32 - Observed and Expected Number of Infant Deaths to French Parents in each Division of Lowertown, 1901

Division	Observed Deaths	Expected Deaths	Division	Observed Deaths	Expected Deaths
By Ward:			Ottawa Ward:		
1	2	2	7	13	10
2	7	5	8	11	8
3	6	5	9	5	4
4	10	7	10	26	19
5	14	13	11	5	4
6	8	6	12	9	9

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

level, the null hypothesis that no difference exists between the observed and expected distributions of infant deaths to French families must be accepted.⁹ In sum, therefore, the observed distribution of deaths of French infants matches the expected distribution of these same deaths. On the other hand, as shown earlier in this chapter, the observed distribution of all infant deaths did not match the expected distribution of these deaths. As a result of these two chi-square analyses, the distributions of deaths of French infants and of all infants do not match and so the geographies of ethnicity and infant mortality are not the same.

In summary, the location of residence, as seen in the previous section has only a marginal effect on the likelihood of a family having an infant death. A few particular blocks and block-faces were more likely to have families with infant deaths than others. However, it has become clear in this section that ethnicity, religion and language have a direct influence on the likelihood of a child dying. These three social

factors have also been shown to be inter-related in that the ancestral origins of a family usually indicates the language spoken and the religion practised. Contrary to expectations illiteracy has been shown not to have a clear role in infant mortality. Finally, this section has provided evidence that suggests that no relationship exists between the geography of ethnicity and the geography of infant death.

Housing

In their examination of mortality differentials between rural and urban areas of the northeastern United States in the 1890's, Condran and Crimmins argue that one of the most fundamental factors in the different mortality rates seen in the rural areas versus the urban areas is population density (Condran and Crimmins, 1980, 202). This link, although not surprising, is not well developed in the literature (Smith and Frost, 1994, 252 - 255). Smith and Frost's recent work focuses on this component of the infant mortality problem in turn of the century Adelaide. Their work was influenced by an article written by Hill in 1919 in which the author claimed that the "relation between density of population and mortality had not altered with improved sanitation and water supplies"(Quoted in Smith and Frost, 1994, 253). Based on Hill's observations, Smith and Frost not only considered population density, as many others have, to be an important contributing factor to the incidence of infant mortality, but also housing type (Gagan, 1989, 163), and internal crowding (Higgs and Booth, 1979, 361; Haines, 1991, 315; Mooney, 1994, 169).

For Lowertown, external density, a term used to describe the density of

population in the surrounding neighbourhood and usually measured by population per acre, has already been examined in Chapter Three at the ward level. In Chapter Three, it was shown that the population density of Lowertown was, in general, twice that of the rest of the city. The link between high population density, poor living conditions and high infant mortality rates has been made elsewhere (Higgs and Booth, 1979, 356). Further evidence to this relationship will be provided throughout the rest of this section using other variables related to density and crowding in the context of the infant mortality of Lowertown. Housing quality as measured by house type and size, family size, and crowding within the home will all be discussed. Housing quality has sometimes been used as a proxy for socio-economic conditions. In light of the results of the previous section with regard to social factors, connections between these social factors and housing quality will be sought. Any connections to economic factors will be addressed in the final section of this chapter.

Chapter Three made reference to the quality and type of housing stock in Lowertown in relation to the rest of the city. Fully seventy-four per cent of Lowertown houses were made of wood, whereas in the rest of the city forty-four per cent were made of wood, which was probably the least durable and least healthy construction material available (manuscript Census of Canada, 1901). In Hamilton, an industrial working class city much like Lowertown, "living conditions in the east end, in particular, had become deplorable: in numerous cases, one-room 'shanties, constructed of rough boards, small and unhygienic, with the interior many times less inviting than the outsides' served as home to a dozen or more immigrant workers"

(Gagan, 1989, 163). This description of Hamilton housing at the turn of the century is just as likely to have been about Lowertown. Lowertown, in 1901, can roughly be characterized as having mostly wooden housing and a modest number, usually in clusters, of brick homes (Goade's Fire Insurance Atlas, 1901; manuscript Census of Canada, 1901). Stone houses and buildings, although few in number lined Sussex Avenue and overlooked both the Ottawa and Rideau rivers (Goade's Fire Insurance Atlas, 1901).

Wood houses accounted for 74 per cent of the Lowertown total. Despite this high proportion, an even higher figure existed for the houses of families with infant deaths; nearly 84 per cent of these houses were made of wood (manuscript Census of Canada, 1901). On the other hand, houses of all three of the other prime building materials; brick, stone and composites were home to families that experienced less than the expected numbers of infant deaths (Table 33). Results of a chi-square test show that this observed distribution of infant deaths in relation to housing type was significantly different than the expected pattern.¹⁰ In other words, wood housing was clearly related to higher rates of infant mortality, while the other three types were linked to lower rates. Figure 19 shows the Lowertown infant deaths by the type of housing in which the family resided.

With a clear statistical link between house type and infant mortality, it seems likely that the spatial distribution of wooden houses would correspond to the spatial pattern of infant death. Analysis at the divisional level reveals that of the four divisions with the highest concentrations of wooden housing (10, 6, 8 and 5), two of

Table 33 - Observed and Expected Number of Infant Deaths for Wood, Brick and Stone and Composite Houses in Lowertown, 1901

Construction Material	Observed Deaths	Expected Deaths
Wood	114	100
Brick	18	23
Stone and Composite	4	13
Total	136	136

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

them, 10 and 5, are among the four divisions identified earlier as having the highest concentrations of infant deaths. These two divisions, with high concentrations of wooden housing relative to their overall populations at 95 per cent and 85 per cent respectively, are the two highest ranking divisions in absolute numbers of infant deaths, 27 and 19 respectively. They are also among the highest in proportion of deaths occurring in wooden housing at 96 per cent and 85 per cent respectively.

For the other two divisions, 6 and 8, with proportionally high concentrations of wooden housing they too had an disproportionately high number of their deaths occurring in wooden houses. In fact, all 20 of their combined infant deaths occurred in wood houses. So, despite their relatively low absolute numbers of deaths, divisions 6 and 8, like divisions 5 and 10, show a strong relationship between infant mortality and wooden housing. Converse to this pattern, the divisions with proportionally low numbers of wooden houses also have low absolute and proportional numbers of infant deaths. Clearly then, the geography of housing type seems to coincide with the

Figure 19 - Infant Deaths by House Type, Lowertown, 1901

geography of infant death. Having a wooden house was associated with an increased probability of having a child die. Similarly, having a large number of neighbouring wooden houses also seemed to worsen the living environment and so resulted in a higher infant mortality rate.

The average household size is one of several effective measures of internal density. High internal density reflects crowding within the home. Family size is another often used measure of this internal crowding, since large families are more likely to result in crowded residences. However, as seen in Lowertown, the more effective of these two measures of crowding is household size because of the considerable number of multiple family homes. Based on the twenty per cent sample population of Lowertown, the average family size for all 610 households was 4.76 persons, while the average dwelling or household size for these same families was 5.67 persons. This discrepancy reflects the large number of boarders, lodgers, domestic servants and extended family members often residing in the homes of Lowertown families, a common occurrence in nineteenth century cities (Harney, 1984, 282-298). In addition, Darroch and Ornstein have shown that many Canadian households in the late nineteenth century consisted of two or more unrelated co-resident families, further contributing to this increased household size (Darroch and Ornstein, 1983). In Lowertown, on average, each family had almost one additional person living in residence which further contributed to household crowding.

Households with infant deaths also had, on average, about one additional person in residence; the average family size of families with deaths was 5.28 and the

average dwelling size was 6.20. Clearly, the households with infant deaths had, on average, more people per family, and also more people per household than did the families without infant deaths (Table 34). A difference of means Z-test found these differences in household size to be significant (Hammond and McCullagh, 1986; Kohler, 1988). A calculated Z value of 2.12 exceeds the critical one-tailed Z value of 1.645 and, therefore, the hypothesis that the mean size of Lowertown households with infant deaths is not significantly different than those households without infant deaths is rejected at the 95 per cent confidence level.¹¹ Clearly, the mean household size of Lowertown families with infant deaths is higher than those families without deaths.

Table 34 - Average Household (Dwelling) Size for Families With and Without Infant Deaths in Lowertown, 1901

Households Without Infant Deaths

n = 610, Mean = 5.67, Standard Deviation = 3.02

Households With Infant Deaths

n = 136, Mean = 6.20, Standard Deviation = 2.91

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

Unlike the geography of house types, differences in household and family sizes do not necessarily seem to coincide with the differences, or geography, of infant death. Again, the four divisions with the highest number and proportion of infant deaths (10, 5, 7 and 8) do not have the highest or lowest average household and family sizes. To the contrary, these four divisions have average family sizes, close to the average for Lowertown as a whole. However, for Ottawa Ward, but not By

Ward, the distribution of family and household size is closely related to the distribution of house types. For example, the three Ottawa Ward divisions with average family sizes greater than five (9, 11 and 12) had proportionally lower percentages of their housing stock made of wood, than did the other three Ottawa Ward divisions which had smaller average family sizes. Clearly then the issue of internal density, or household crowding, is more complicated than simply being a reflection of family or household size.

Perhaps then, a better measure of crowding is the size of a house, through the number of rooms rather than the size of the family. Dr. Bryett, the Medical Officer of Health for the borough of Shoreditch in east London in 1911 believed the number of rooms, or house size, to be an important factor in higher mortality rates. He wrote,

[i]n a densely populated working-class district, such as Shoreditch is, where three-fourths of the population live in tenements of less than five rooms, and a large proportion of these in tenements of only one or two rooms there are consequent conditions which facilitate the spread of the infection of diarrhoea in families and generally predispose to prevalence of the disease (Bryett, Quoted in Mooney, 1994, 169).

In a study of turn of the century infant mortality in England and Wales, Haines found a clear and predictable relationship between infant death and the number of rooms in the dwelling (Haines, 1995, 315). In support of these findings for England and Wales, the number of rooms per dwelling also had a significant effect on the rates of infant mortality in Ottawa (Table 35). A calculated Z value of - 1.77 is greater than the critical one-tailed Z value of - 1.645 and therefore, the hypothesis that the mean size

of Lowertown households, as measured by rooms per dwelling, with infant deaths is not significantly different than those households without infant deaths is rejected at the 95 per cent confidence level.¹² Therefore, the size of dwellings of families with infant deaths is significantly smaller than those dwellings of families without deaths.

Table 35 - Average Number of Rooms per Dwelling for Households With and Without Infant Deaths in Lowertown, 1901

Households Without Infant Deaths

n = 600, Mean = 6.71, Standard Deviation = 3.12

Households With Infant Deaths

n = 136, Mean = 6.30, Standard Deviation = 2.70

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

So, family size and number of rooms per dwelling are indicators of patterns of infant mortality. In fact, researchers have often found that overall population density can be misleading because of the existence of pockets of high density homes and even extreme crowding within individual homes (Smith and Frost, 1994, 269; Higgs and Booth, 1979, 361; Haines, 1995, 315). In Adelaide, Smith and Frost found that conditions and density within the home were at least as important as density outside the home (Smith and Frost, 1994, 270). By this they mean that measures of persons per room are more indicative of 'true' crowding than family size, size of dwelling or even persons per acre. Childhood mortality in large American cities in 1890, as studied by Higgs and Booth, was much more responsive to changes in internal rather than external density (Higgs and Booth, 1979, 367).

The distribution of infant deaths among seven internal crowding categories was found to be significantly different from the expected distribution based on the Lowertown population as a whole (Table 36). Using a chi-square test, the null hypothesis that the observed and expected distributions of infant deaths, based on the number of persons per room, were not significantly different, was rejected at the 95 per cent confidence level.¹³ Clearly, based on the proportion of the sample population of Lowertown, many more deaths were expected in houses with less than half a person per room (class one) and somewhat fewer deaths in houses with more than one person per room (classes four through seven). Over 60 (44 per cent) of all households with infant deaths had more than one person per room, while only 29 per cent of the Lowertown households as a whole had this much crowding. Clearly, crowding within the home was found to be associated with the incidence of infant deaths. This result confirms the patterns seen by others for American and Australian cities. Figure 20 shows the infant deaths by the level of internal crowding in which the infant lived.

The geographical distribution of this relationship is clear. For almost all divisions, the proportion of households with household densities greater than 1.5 person per room was higher for families with infant deaths than for those without (with the exception of three divisions where the number of infant deaths is too small to generate any meaningful results) (Table 37). Like the distribution of family size, the distribution of internal crowding matches better with the spatial pattern of house type than infant mortality directly. Those divisions with a high proportion of the houses

Table 36 - Categories of Internal Crowding (Persons/Room) and the Observed and Expected Number of Infant Deaths for Each Category, Lowertown, 1901

Class #	Class Range (Persons/Room)	Sample Households	Deaths	Expected Deaths
1	0.00 - 0.50	143	14	32
2	0.51 - 0.75	123	27	28
3	0.76 - 1.00	160	34	36
4	1.01 - 1.25	60	20	14
5	1.26 - 1.50	57	22	13
6	1.51 - 1.75	19	6	4
7	1.76 - ++	38	13	9
Total		600	136	136

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

having low internal crowding, less than one person per room, also had high proportions of the housing stock made of brick or stone. Divisions one, two and three are appropriate examples; each has greater than fifty per cent of the housing made of brick, stone and composites and greater than 75 per cent of the households with less than one person per room.

The opposite result is also apparent. The divisions with high average household and family sizes and a high proportion of the houses with high internal density or crowding also had a high proportion of houses constructed with wood. Divisions six, eight and ten are appropriate examples for this case; each had greater than 85 per cent of the housing made of wood and close to thirty per cent of the households with greater than one person per room. Therefore, the houses were of the least desirable material and generally crowded. A similar relationship was found for

Figure 20 - Infant Deaths by Category of Internal Crowding, Lowertown, 1901

Source: Based on DesRosiers, 1912; Goade's Fire Insurance Plan, 1901; Civil Death Registry, 1901; Manuscript Census of Canada, 1901

Scale: 1:12 350

Table 37 - Percentage of Households (With or Without Infant Deaths) With High Internal Crowding, Lowertown, 1901

Division	Percentage of Households Without Infant Deaths	Percentage of Households With Infant Deaths
1	11.1 *	0.0
2	22.8	18.2
3	11.3	14.3
4	16.2	10.0
5	11.6	15.8
6	6.2	0.0
7	7.3	14.3
8	18.6	18.1
9	3.6	16.7
10	4.6	14.9
11	5.4	0.0
12	13.4	30.7

* - per cent of households with greater than 1.5 persons per room.

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

streets in the Port Adelaide suburb in the study by Smith and Frost (Smith and Frost, 1994, 267).

A final measure of density and the effect of housing on infant mortality incorporates the use of the block-face. Previous analyses in this thesis have shown that external density, measured at the ward and divisional level, is associated with differing rates of infant mortality. Similarly, analyses of internal density, as seen through measures of crowding, have also been found to be associated with infant death. Clearly, crowding within the home and in the neighbourhood are related to

the incidence of infant mortality. However, what 'defines' the neighbourhood? The ward and the division are clearly involved, but what about the block-face? Does population density of the block-face affect infant mortality rates? Apparently it does. Block-face analysis reveals that for those blocks without infant deaths, the average number of residents was just under 56 people, while for those blocks with infant deaths almost 97 people were residing there (Table 38). A difference of means test shows that for those blocks-faces with infant deaths the average population size is significantly higher than the average population for block-faces without deaths.¹⁴

Table 38- Average Population Size for Block-Faces With and Without Infant Deaths, Lowertown, 1901

Block-Faces Without Infant Deaths

n = 140, Mean = 55.7, Standard Deviation = 47.9

Block-Faces With Infant Deaths

n = 86, Mean = 96.5, Standard Deviation = 66.9

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

Overall, it seems clear that the type of house and the crowding of persons within it and in the surrounding neighbourhood are significantly related to the incidence of infant mortality in turn of the century Lowertown. Those districts and block-faces with high concentrations of infant deaths were often densely populated with internally crowded, wooden houses. Those districts with fewer infant deaths were found to have fewer wooden houses, and proportionally more houses made of brick and stone which were also often less crowded inside. These latter

neighbourhoods were also less densely populated. What has yet to be determined, however, is the relationship between these houses and the economic class and standards of living enjoyed by their inhabitants. Connections between housing and infant mortality and the economic standard of living of families will be pursued in the next section.

Economic Factors

The importance of economic factors in determining the location and incidence of infant mortality has been alluded to in the discussion of the other factors in this chapter. Specifically, within the housing category each of the most important variables discussed is obviously related to the economic status of the resident families. The type of material used in the construction of a house would most likely have been determined by the economic capital available to the home owner. Similarly, for those who were renting their properties from absent landlords, the rent of the properties would surely have been related to the quality of materials and construction of the home as well as its location. Other factors such as size of the dwelling, the number of people required to share a limited amount of space in a dwelling and finally, the density with which houses are located on the land, all have an obvious underlying economic component to them. However, it is difficult to extend these relationships beyond what has already been done here; this is an often observed function of land and urban economics (Bairoch, 1988, 271-276; Engels, 1958, 108-149; Harvey, 1989,

90-108; Hohenberg and Lees, 1985, 295-298). Nonetheless, several economic variables extracted from the various data sources can shed some more light on the importance of economic status on the social environment and on the infant mortality rate. To this end, income, occupation and assessed value of property will now be explored.

As Mooney has pointed out, policies implemented in late nineteenth century London designed to help families improve their overall level of health and to 'educate' mothers in the provision of adequate care for infant children, while useful to a certain degree, were often hampered by the absolute poverty in which the residents lived (Mooney, 1994, 172). Clearly, by the late nineteenth century many health experts and urban reformers had already determined that a link between poverty and ill-health existed and that in order to 'clean up' the social environment and improve the health of all urban residents, and particularly infants, the issue of poverty needed to be addressed (Mooney, 1994, 166-173; Richardson, 1901, 837-860 and 1043-1228). The question that arises here, is what economic differences existed between the families with and without infant deaths?

Income is often a problematic variable to use in the assessment of cultural or regional differences. As Thornton and Olson found out for mid-nineteenth century Montreal, the income effect on infant mortality was muted by the dominant cultural differences between the three primary groups; French Canadian, Irish Catholic and British Protestant (Thornton and Olson, 1994, 404). The difficulty that they encountered was that each cultural group was somewhat equally represented in each

economic class and so they found that any effect income had on mortality was concealed by cultural differences. Similar results were found for Lowertown where the overall average income, based on the twenty per cent sample, was \$541 per family (Table 39). Among the four major categories of ethnicity in Lowertown; French, Irish, English and other, none has a significantly different average income than the average for the whole of Lowertown.¹⁵ Interestingly, the Scottish with 18 households and a further twelve households of other ethnicities such as African, Chinese, Italian, German and Scandinavian had on average much higher income at \$598 per household, although the grouping is without substantive meaning.

Similar to Montreal, Lowertown's income distribution was not substantially dependent on ethnicity, as it appears that each ethnicity was possibly represented in each economic class. However, without a monetary definition of economic class this is difficult to justify. An alternative explanation is that the entire region of Lowertown was represented by one class. In relation to income and infant mortality, Watterson, in her study of 1911 England and Wales, has found that

changes taking place in the urban environment centred on improvements in sanitation, sewage, and refuse removal and disposal were very important. These falls could take place at any level of income but were enhanced by high or regular income. Increasing income on its own, however, would not necessarily have produced a steeper decline in infant mortality... (1988, 302).

A class analysis undertaken by Watterson shows that higher incomes do not necessarily lower the infant mortality rates. She demonstrates that economic class, as determined by occupation, 'social status' and land ownership, not income, was key in influencing the rates of infant death (Watterson, 1988, 296).

Table 39 - Average Annual Income (Dollars) for all Households in Lowertown and for each Specific Ethnic Group, 1901

Income of all Households in Lowertown
 n = 475, Mean = 541.0, Standard Deviation = 338.4

Income for Households of French Ethnicity
 n = 350, Mean = 536.6, Standard Deviation = 331.9

Income for Households of Irish Ethnicity
 n = 52, Mean = 531.9, Standard Deviation = 315.9

Income for Households of English Ethnicity
 n = 34, Mean = 535.4, Standard Deviation = 365.4

Income for Households of all other Ethnicities
 n = 39, Mean = 597.7, Standard Deviation = 403.6

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

This leads to the fundamental problem of the use of income data for Ottawa in 1901. In many cases, the Census does not list an income for the head of a household, often because he/she was self-employed or simply refused to provide the information to the census taker. The impact of this data limitation is that it calls into question any results based on income because the distribution of households without reported incomes is not equally distributed across Lowertown. To see this more clearly, the average income and standard deviation, number of households with reported income and the proportion that these households made of the entire twenty per cent sample population were all determined for each of the twelve Lowertown divisions (Table 40).

Overall, 78 per cent of households had a reported income, but as Table 40 shows this was not evenly represented in each division. Some divisions were nearly

Table 40 - Average Income for Households with Reported Income, by Division, Lowertown, 1901

Div.	Avg. Income & (Std. Dev)	Households with Income	Households Total	Percentage of all Households in Division with Reported Income
1	\$445.5 (\$266.1)	13	27	48.1
2	\$463.2 (\$201.1)	24	35	68.6
3	\$406.9 (\$188.7)	28	44	63.6
4	\$427.8 (\$254.2)	36	37	97.3
5	\$436.9 (\$185.8)	60	69	87.0
6	\$387.6 (\$156.7)	58	64	90.6
7	\$577.0 (\$450.7)	41	55	74.5
8	\$575.3 (\$238.5)	62	75	82.7
9	\$739.0 (\$515.6)	44	56	78.6
10	\$508.7 (\$201.6)	31	44	70.5
11	\$767.7 (\$455.1)	29	37	78.4
12	\$708.7 (\$402.8)	49	67	73.1
Total	\$541.0 (\$338.4)	475	610	77.9

(Source: Compiled by the author)

entirely covered, while most were in the range of seventy to eighty per cent coverage. However, the first three divisions, and particularly division one, had proportionally few of the sample households with a reported income and were therefore not very well represented by this income variable. The effect that this under-representation has on the results is that, given the proportionally low number of deaths in these first three divisions, the average income for them seems remarkably low. The hypothesis here, similar to that derived by Woods, Watterson and Woodward, is that the divisions with low numbers of deaths would be economically more well off than others and as such, have a better living environment and fewer infant deaths (Woods, Watterson and Woodward, 1988, 365). The results for Lowertown appear to show the opposite to be

true; divisions with low numbers of infant death also have relatively low average income levels. The under-representation of income data, especially from the higher income households, appears to be responsible for this pattern. Indeed, a low Spearman's Rank Correlation Coefficient of 0.416, as compared to a critical value of 0.506 for twelve pairs, suggests that no significant correlation exists between the number of households with a reported income and the number of infant deaths in the twelve divisions of Lowertown.¹⁶

Similar patterns are seen for those households with both a reported income and an infant death in the family. Based on the data for households with infant deaths, four divisions have 100 per cent of their households reporting an income, while divisions one through three are again considerably below the average (Table 41). The overall mean annual income for households with both an infant death and a reported income (mean = \$587, standard deviation = \$371) was higher than for those families without a death (mean = \$541, standard deviation = \$338). Possible explanations can be found for this pattern. The mean income for families with infant deaths may simply be higher than for those families without deaths. However, a more likely explanation is that there were fewer high income, or wealthy, families in Lowertown that had infant deaths. Since, as has been argued previously, wealthy families were less likely to report an income than their poorer counterparts then the lower mean annual income for families without deaths may be the result of the wealthy families' tendency not to report their incomes.

If these data, based on the families with infant deaths rather than those without,

Table 41 - Average Income for Households with Infant Deaths and with Reported Income, by Division, Lowertown, 1901

Div.	Avg. Income & (Std. Dev)	Households with Infant Deaths & Income	Households with Infant Deaths	Percentage of all 'Infant Death' Households in Division with a Reported Income
1	\$350.0 (N/A)	1	3	33.3
2	\$682.9 (\$456.8)	7	11	63.6
3	\$591.2 (\$383.8)	5	7	71.4
4	\$760.8 (\$384.8)	9	10	90.0
5	\$452.4 (\$158.8)	16	19	84.2
6	\$401.7 (\$163.7)	9	9	100.0
7	\$530.8 (\$228.6)	11	14	78.6
8	\$504.7 (\$203.5)	11	11	100.0
9	\$737.0 (\$621.5)	6	6	100.0
10	\$470.2 (\$163.0)	23	27	85.2
11	\$853.0 (\$705.2)	5	6	83.3
12	\$878.3 (\$560.1)	13	13	100.0
Total	\$587.0 (\$371.0)	116	136	85.3

(Source: Compiled by the author)

are accepted as a better, but not ideal, measure of the income effect, then some interesting patterns can be discerned. Three of the four divisions with the highest numbers of infant deaths have among the lowest average family incomes. Similarly, these same three divisions are also amongst the lowest in terms of average income per household member. Similarly, a Spearman's Rank Correlation Coefficient of 0.92, as compared to a critical value of 0.506, suggests that the number of households with an infant death and a reported income in a division is correlated with the number of infant deaths in that division.¹⁷ Despite these encouraging results, the effect of the under-representation of some divisions with respect to income, severely restricts the

ability to make strong conclusions about a relationship between income and infant mortality.

Another variable that has received considerable attention in the social environment and infant mortality literature is occupation of the head of household. The literature has shown that the occupation of a household head is a reliable indicator of socio-economic standing within the community and therefore contributes to the environmental living conditions of the family (Watterson, 1998; Woods, Watterson and Woodward, 1988; Lee, 1991; Dyhouse, 1978; Olson and Hanna, 1990). Lee found that in Britain between 1861 and 1971, the infant mortality rate declined drastically. He argues that this is because the economy gradually turned away from heavy industrial employment and therefore the living conditions of families improved as standards of living also improved (Lee, 1991, 64-65). Woods, Watterson and Woodward show that infant mortality rates were significantly different between social classes of England and Wales from 1861 to 1921 (Woods, Watterson and Woodward, 1988, 364). In 1901, England and Wales' infant mortality rate was 139 for the population as a whole, including both the employed and unemployed, and in contrast it was only 83 for the upper and middle classes (Woods, Watterson and Woodward, 1988, 364). The working class, on the other hand, made up of skilled and unskilled workers, textile workers, and miners had infant mortality rates ranging from 121 to 145 (Woods, Watterson and Woodward, 1988, 363).

In Lowertown, those with occupations were grouped into five categories; government employees, including civil servants and Members of Parliament;

professionals, including accountants, office clerks, managers and merchants; service employees, including barbers, hotel keepers, grocers and drivers; skilled labourers, including blacksmiths, carpenters, bricklayers and millwrights; and finally semi-skilled labourers, including general labourers, day labourers, servants and mill hands (Blishen and McRoberts, 1976, 71-79; Blishen, 1967, 41-53; Pineo and Porter, 1967, 24-40). Nearly 90 per cent of the sample household heads had an occupation, while all 100 per cent of the household heads of families with infant deaths had reported occupations. The distributions of household heads within the occupational categories for both the sample families and those with infant deaths were almost identical. A third of all household heads were employed as semi-skilled labourers, a further fifty per cent worked as either a service employee or skilled tradesman. Seven per cent of the population were government employees while a further seven per cent were professionals.

No clear discernible pattern of occupational status existed. Several concentrations of occupations such as proportionally high levels of professionals and government employees existed in the three commercial core divisions of By Ward. For the other occupational categories, the distribution seems to have no clear pattern and the distribution of occupational status for those household heads that had infant deaths matched, for the most part, the general distribution (Table 42). So, no clear pattern of occupation or income can be drawn from the data. This means that each division, on average, had an equal proportion of household heads participating in each occupational category, and therefore, based on this method of occupational

Table 42 - Occupations of Households Heads With and Without Infant Deaths, Lowertown, 1901

Occupational Category	Households Without a Death	Percentage of all Households Without a Death	Households With a Death	Percentage of all Households With a Death
Government	42	7.8	13	9.6
Professional	39	7.3	11	8.1
Service	127	23.7	34	25.0
Skilled	147	27.4	31	22.3
Semi-Skilled	182	33.9	47	34.5
Total	537*		136	

* 73 household heads reported no occupation

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

categorization, no geography of occupation exists or is discernible from the data.

Yet, a relationship between income and occupational status did exist in 1901 both for those families with infant deaths and those without. Only 39 household heads reported an occupation in the professional category and only 21 of them reported an income; nevertheless their average annual income was the highest of all occupational categories at \$832 per year (Table 43). Based on the 475 households of the original sample population that reported both an occupation and an income, the average income was \$541. The next highest average income was for the government employees at \$648, followed closely by skilled craftsmen at just under \$600 per year. Service employees had average incomes just below the regional average, and the semi-skilled labourers, encompassing almost 34 per cent of all people with registered occupations.

Table 43 Mean Annual Income (Dollars) for Seven Major Occupational Groups, Lowertown, 1901

Income of all Occupational Types in Lowertown

n = 475, Mean = 541.0, Standard Deviation = 338.4

Income for Households employed in Government sector

n = 40, Mean = 648.4, Standard Deviation = 490.1

Income for Households employed as a Professional

n = 21, Mean = 832.2, Standard Deviation = 547.7

Income for Households employed in Service sector

n = 81, Mean = 523.7, Standard Deviation = 317.7

Income for Households employed as a Skilled Labourer

n = 131, Mean = 597.3, Standard Deviation = 292.8

Income for Households employed as a Semi-Skilled Labourer

n = 176, Mean = 446.3, Standard Deviation = 275.3

Income for Households employed, but no specific occupation given

n = 26, Mean = 552.4, Standard Deviation = 293.9

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

earned almost one hundred dollars less than the average.

A difference of means test based on the average annual incomes of each occupational category and the average for all households with a reported income and occupation was performed.¹⁸ The results of this test reveal that the average income for household-heads employed in all occupational categories with the exception of professional, skilled and semi-skilled are not significantly different from the average of all occupations. Household heads employed as professionals or skilled labourers enjoyed significantly higher average incomes than the rest of the employed population,

while semi-skilled labourers had significantly lower average incomes. Unfortunately, since the structure of occupations is the same for both the household heads with infant deaths and those without and that no discernable spatial pattern exists for occupations, then it is difficult to say that occupational status had any impact on the incidence of infant mortality.

The final economic variable studied is the assessed value of land. This variable measures the assessed value of properties, land and building in 1896, the closest available assessment roll for Ottawa. The assessed value of property was found for almost all 610 sample households and 136 infant death households. The predicted relationship between assessed value and infant mortality is that those households with an infant death would have an assessed value less than those households without an infant death. At the regional level (Lowertown) that prediction is validated. The average assessed value for the sample population was \$682, while for the infant death households the value was \$606 (Table 44). A difference of means test revealed that this difference was significant at the 95 per cent confidence level.¹⁹

Table 44 Average Assessed Value of Property for Households With and Without Infant Deaths, Lowertown, 1901

Assessed Value of Property for Households without Infant Deaths
 n = 605, Mean = 681.7, Standard Deviation = 638.2

Assessed Value of Property for Households with Infant Deaths
 n = 136, Mean = 605.7, Standard Deviation = 497.9

(Source: Compiled by the author from the manuscript Census of Canada, 1901)

Spatially, the divisions with the fewest number and lowest proportion of infant deaths often had the highest assessed value of property. Divisions one through four, the divisions closest to the commercial core of Ottawa, had only 22 per cent of the infant deaths and an average assessed value of over one thousand dollars, over 300 higher than the average for Lowertown (Table 45). On the other hand, divisions five through eight had almost 40 per cent of the infant deaths and their combined average of assessed value was more than 100 dollars below the Lowertown average.

Essentially the same pattern existed for the households with infant deaths. For the households of division ten, in both the general population and the sample of infant deaths, the assessed value was over \$200 below the average for Lowertown. In general, the division with the fewest deaths (one) had the highest assessed value. In comparison, the division with the most number of infant deaths (ten) had the lowest assessed value.

Assessed value has a link to infant mortality; presumably it mirrors wealth generally. Those regions with the poorest neighbourhoods, as defined by the combined assessed value of property and building, also had the highest numbers of infant deaths. A Spearman rank correlation test confirmed that a significant negative correlation existed between the assessed value of houses in each division and the number of infant deaths that occurred there.²⁰ In other words, at the divisional scale, the houses with the highest assessed values also have the fewest number of infant deaths.

Table 45 - Assessed Value of Property and Infant Deaths by Division, Lowertown, 1901

Division	Average Assessed Value of All Households	Infant Deaths	Average Assessed Value of Households with Infant Deaths
1	\$ 1306	3	\$ 1517
2	\$ 1107	11	\$ 1089
3	\$ 898	7	\$ 543
4	\$ 921	10	\$ 718
5	\$ 532	19	\$ 613
6	\$ 473	9	\$ 456
7	\$ 727	14	\$ 491
8	\$ 544	11	\$ 420
9	\$ 711	6	\$ 575
10	\$ 430	27	\$ 407
11	\$ 730	6	\$ 925
12	\$ 535	13	\$ 587
Total/Avg.	\$ 682	136	\$ 606

(Source: Compiled by the author from the manuscript Census of Canada, 1901 and Assessment Roll, 1896)

Therefore, with regards to economic indicators of poor living conditions and their relationship to infant mortality, the value of assessed property seems to be the best indicator of these conditions. Those regions with the lowest assessed value, on average had the higher number of infant deaths and so by extension likely had worse household living environments. In terms of the other economic factors, occupation is marginally relevant and its usefulness as a measure of economic standing is limited. In addition, income has also been shown to be an unreliable indicator of economic conditions because of the high number of households that, for one reason or another, did not report an income for 1901. This drawback in data limits the effectiveness of

this variable.

Conclusions:

The purpose of this chapter was first of all to examine the geographical distribution of infant deaths in Lowertown and secondly, to establish which factors within the home contributed to a higher likelihood of an infant death occurring. These internal factors include the social, economic and housing conditions characteristic of each family dwelling.

In Ottawa as a whole, it is clear that infant deaths and the poorest living conditions were both concentrated in Lowertown. There is, therefore, a clear spatial pattern of infant mortality at the city level. However, as identified at the beginning of this chapter, Lowertown's infant deaths were not as clearly spatially clustered. In fact, the distribution of infant deaths in Lowertown is more nearly random. In some divisions and on some streets, blocks and block-faces the number of infant deaths is higher than others. Despite this, taken as a whole, Lowertown presents only a marginally clustered spatial pattern. Analysis of the seasonal occurrences and environmentally related causes of death supports this conclusion that location, within Lowertown, had only a minor impact on the incidence of infant mortality.

Of the social factors, ethnicity, religion and language were all found to be significantly related to the incidence of infant mortality and also to each other. The most susceptible ethnic group was the French, and their rates were shown to be

significantly different from the rest of the population. Roman Catholics and French-speaking families also had an increased chance of having an infant death than did others. Literacy, and its opposite illiteracy, were not found to have a significant impact on the likelihood of a family suffering from an infant death, despite expectations otherwise.

Housing conditions were also found to influence infant mortality. Specifically, Lowertown families living in wooden houses were the most likely to have infants die. In addition, both measures of population density, internal and external, were also related to the rates of infant mortality. Neighbourhoods with high external population densities, that is high ratios of persons per acre, had higher mortality rates, and similarly those households with high ratios of persons per room, internal density, also had higher rates of mortality. Family size and number of rooms per dwelling were also determined to be significant.

Although economic conditions clearly underlie the housing factors discussed above, of the true economic indicators only the assessed value of property proved to be a reliable measure of economic standing. The lower a property's assessed value the greater the likelihood that the resident family would suffer an infant death. Unfortunately occupational categories and measures of income were found to be limited as indicators of living standards because of problems in the collection of data.

This chapter has focussed specifically on the infant deaths that occurred within Lowertown. Within this district, no clearly discernible spatial pattern of deaths exists, despite a slight clustering pattern of diarrhoeal related deaths. Other factors such as

ethnicity, house type and assessed land value, among others discussed here, have all been found to be related to the incidence of infant mortality.

Notes - Chapter Five

1. Chi-square statistic = 41.94. Critical value of the chi-square = 19.67; with eleven degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between the twelve divisions of Lowertown and the expected pattern based on the proportion of the population. Since $41.94 > 19.67$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

2. Sum of Nearest Neighbour Distances = 109.2, $n = 136$, Area = 447.75.
 Mean Nearest Neighbour Distance (NND-Obs.) = 0.8029.
 Expected Mean Nearest Neighbour Distance (NND-Exp) = 0.9072.

Nearest Neighbour Index (R) = 0.8850.

Hypothesis (Null) - The pattern of infant deaths in Lowertown is similar to a pattern produced by a random process.

Standard Deviation of NND-Exp = 0.0407

Z (calculated) = 2.56

Z (critical) = 1.96, at 0.05 significance level

Since $2.56 > 1.96$, then the null hypothesis is rejected at the 95 per cent confidence level.

For the significance of using Z in Nearest Neighbour Analysis see Hammond and McCullagh, 1986, 274.

3.

a) Diarrhoeal Deaths:

Sum of Nearest Neighbour Distances = 62.4, $n = 64$, Area = 447.75

Mean Nearest Neighbour Distance (NND-Obs.) = 0.9750.

Expected Mean Nearest Neighbour Distance (NND-Exp.) = 1.3225.

Nearest Neighbour Index (R) = 0.7372.

b) Non-Diarrhoeal Deaths:

Sum of Nearest Neighbour Distances = 90.7, $n = 72$, Area = 447.75

Mean Nearest Neighbour Distance (NND-Obs.) = 1.2597.

Expected Mean Nearest Neighbour Distance (NND-Exp.) = 1.2469.

Nearest Neighbour Index (R) = 1.0103.

4. Cholera:

Sum of Nearest Neighbour Distances = 55.3, $n = 27$, Area = 447.75

Mean Nearest Neighbour Distance (NND-Obs.) = 2.0481.

Expected Mean Nearest Neighbour Distance (NND-Exp.) = 2.0361.

Nearest Neighbour Index (R) = 1.0069.

5.

a) Diarrhoea:

Sum of Nearest Neighbour Distances = 24.8, $n = 7$, Area = 447.75

Mean Nearest Neighbour Distance (NND-Obs.) = 3.5429.

Expected Mean Nearest Neighbour Distance (NND-Exp.) = 3.9989.

Nearest Neighbour Index (R) = 0.8853.

b) Debility and Asthenia:

Sum of Nearest Neighbour Distances = 37.5, $n = 24$, Area = 447.75

Mean Nearest Neighbour Distance (NND-Obs.) = 1.5625.

Expected Mean Nearest Neighbour Distance (NND-Exp.) = 2.1596.

Nearest Neighbour Index (R) = 0.7235.

c) Other Diarrhoeal (Enteritis and Marasmus):

Sum of Nearest Neighbour Distances = 17.6, $n = 6$, Area = 447.75

Mean Nearest Neighbour Distance (NND-Obs.) = 2.9333.

Expected Mean Nearest Neighbour Distance (NND-Exp.) = 4.3193.

Nearest Neighbour Index (R) = 0.6791.

6.

a) Fathers:

Chi-square statistic = 14.41. Critical value of the chi-square = 7.82; with three degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between four ethnic groups (French, Irish, English and other) in Lowertown and the expected pattern based on the proportion of the population. Since $14.41 > 7.82$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

b) Mothers:

Chi-square statistic = 13.27. Critical value of the chi-square = 7.82; with three degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between four ethnic groups (French, Irish, English and other) in Lowertown and the expected pattern based on the proportion of the population. Since $13.27 > 7.82$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

7.

a) Fathers:

Chi-square statistic = 7.09. Critical value of the chi-square = 3.81; with one degree of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between two categories of religious affiliation (Roman Catholic and non-Catholic) in Lowertown and the expected pattern based on the proportion of the population. Since $7.09 > 3.81$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

b) Mothers:

Chi-square statistic = 7.09. Critical value of the chi-square = 3.81; with one degree of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between two categories of religious affiliation (Roman Catholic and non-Catholic) in Lowertown and the expected pattern based on the proportion of the population. Since $7.09 > 3.81$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

8.

a) Fathers:

Chi-square statistic = 2.43. Critical value of the chi-square = 5.99; with two degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between three categories of literacy of fathers in Lowertown and the expected pattern based on the proportion of the population. Since $2.43 < 5.99$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

b) Mothers:

Chi-square statistic = 0.58. Critical value of the chi-square = 5.99; with two degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between three categories of literacy of mothers in Lowertown and the expected pattern based on the proportion of the population. Since $0.58 < 5.99$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

9. Chi-square statistic = 7.93. Critical value of the chi-square = 19.68; with eleven degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths of French parents between the twelve divisions of Lowertown and the expected pattern based on the proportion of the population. Since $7.93 < 19.68$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

Statistical purists will note that 25 per cent of the twelve expected values are below five; chi-square requirements only allow for 20 per cent. By adding two deaths to each division, the expected deaths for divisions nine and eleven became sufficiently high to meet

the chi-square requirements (Greene, 1990, 300-306; Pindyck and Rubinfeld, 1991, 505-506). A new chi-square statistic was calculated (16.22) which was still below the critical chi-square value of 19.68. Therefore, with this revised chi-square test, the result, that the observed pattern of infant deaths to French parents was not significantly different from the expected pattern based on the proportion of the population, was confirmed.

10. Chi-square statistic = 9.28. Critical value of the chi-square = 5.99; with two degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between houses constructed of wood, brick or stone and composite in Lowertown and the expected pattern based on the proportion of the population. Since $9.28 > 5.99$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

11. Calculated $Z = 2.12$; Critical $Z = 1.645$ at the 95 per cent confidence level and a one-tailed (upper tail) test. Hypothesis (Null) - The mean size of Lowertown households with infant deaths is not significantly different than the households without infant deaths. Since $2.12 > 1.645$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

12. Calculated $Z = -1.77$; Critical $Z = -1.645$ at the 95 per cent confidence level and a one-tailed (lower tail) test. Hypothesis (Null) - The mean size of Lowertown households, as measured by rooms per dwelling, with infant deaths is not significantly different than the households without infant deaths. Since $-1.77 < -1.645$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

13. Chi-square statistic = 21.85. Critical value of the chi-square = 12.59; with six degrees of freedom at the 95 per cent confidence level. Hypothesis (null) - There is no significant difference in the observed pattern of infant deaths between the seven categories of internal crowding for Lowertown and the expected pattern based on the proportion of the population. Since $21.85 > 12.59$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

14. Calculated $Z = 5.32$; Critical $Z = 1.645$ at the 95 per cent confidence level and a one-tailed (upper tail) test. Hypothesis (Null) - The mean population size of Lowertown block-faces, as measured by persons per block-face, with infant deaths is not significantly different than the households without infant deaths. Since $5.32 > 1.645$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

15.

a) Households of French ethnicity vs. all Households in Lowertown:
Calculated $Z = -0.248$; Critical $Z = -1.645$ at the 95 per cent confidence level and a one-tailed (lower tail) test. Hypothesis (Null) - The mean income of households of French ethnicity in Lowertown is not significantly different than all the households in Lowertown. Since $-0.248 > -1.645$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

b) Households of Irish ethnicity vs. all Households in Lowertown:

Calculated $Z = -0.208$; Critical $Z = -1.645$ at the 95 per cent confidence level and a one-tailed (lower tail) test. Hypothesis (Null) - The mean income of households of Irish ethnicity in Lowertown is not significantly different than all the households in Lowertown. Since $-0.208 > -1.645$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

c) Households of English ethnicity vs. all Households in Lowertown:

Calculated $Z = -0.089$; Critical $Z = -1.645$ at the 95 per cent confidence level and a one-tailed (lower tail) test. Hypothesis (Null) - The mean income of households of English ethnicity in Lowertown is not significantly different than all the households in Lowertown. Since $-0.089 > -1.645$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

d) Households of all other ethnicities vs. all Households in Lowertown:

Calculated $Z = 0.877$; Critical $Z = 1.645$ at the 95 per cent confidence level and a one-tailed (upper tail) test. Hypothesis (Null) - The mean income of households of any 'other' ethnicity (not French, Irish or English) in Lowertown is not significantly different than all the households in Lowertown. Since $0.877 < 1.645$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

16. Spearman's Rank Correlation Coefficient (R_s) = 0.416

Critical value of $R_s = 0.506$; with $n = 12$ and 0.05 significance level.

Hypothesis (Null) - There is no correlation between the number of households in a division that report an income and the number of infant deaths. Since $0.416 < 0.506$, then the null hypothesis is accepted at the 0.05 (95 per cent) significant level.

17. Spearman's Rank Correlation Coefficient (R_s) = 0.920

Critical value of $R_s = 0.506$; with $n = 12$ and 0.05 significance level.

Hypothesis (Null) - There is no correlation between the number of households in a division that report an income and have an infant death and the number of infant deaths in that division. Since $0.920 > 0.506$, then the null hypothesis is rejected at the 0.05 (95 per cent) significant level.

18.

a) Household Heads employed in Government sector vs. Household Heads in all

Occupational Categories:

Calculated $Z = 1.39$; Critical $Z = 1.645$ at the 95 per cent confidence level and a one-tailed (upper tail) test. Hypothesis (Null) - The mean income of household heads employed in the government sector is not significantly different than for those employed in all occupational groups. Since $1.39 < 1.645$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

b) Household Heads employed as a Professional vs. Household Heads in all Occupational

Categories:

Calculated $Z = 2.44$; Critical $Z = 1.645$ at the 95 per cent confidence level and a one-tailed (upper tail) test. Hypothesis (Null) - The mean income of household heads employed as a professional is not significantly different than for those employed in all occupational groups. Since $2.44 > 1.645$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

c) Household Heads employed in Service sector vs. Household Heads in all Occupational Categories:

Calculated $Z = -0.49$; Critical $Z = -1.645$ at the 95 per cent confidence level and a one-tailed (lower tail) test. Hypothesis (Null) - The mean income of households employed in the service sector is not significantly different than for those employed in all occupational groups. Since $-0.49 < -1.645$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

d) Household Heads employed as a Skilled Labourer vs. Household Heads in all Occupational Categories:

Calculated $Z = 2.20$; Critical $Z = 1.645$ at the 95 per cent confidence level and a one-tailed (upper tail) test. Hypothesis (Null) - The mean income of household heads employed as skilled labourers is not significantly different than for those employed in all occupational groups. Since $2.20 > 1.645$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

e) Household Heads employed as a Semi-Skilled Labourer vs. Household Heads in all Occupational Categories:

Calculated $Z = -4.56$; Critical $Z = -1.645$ at the 95 per cent confidence level and a one-tailed (lower tail) test. Hypothesis (Null) - The mean income of household heads employed as semi-skilled labourers is not significantly different than for those employed in all occupational groups. Since $-4.56 > -1.645$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

f) Household Heads employed, but in no specific occupation vs. Household Heads in all Occupational Categories:

Calculated $Z = 0.198$; Critical $Z = 1.645$ at the 95 per cent confidence level and a one-tailed (upper tail) test. Hypothesis (Null) - The mean income of household heads employed in no specific occupational group is not significantly different than for those employed in all occupational groups. Since $0.198 < 1.645$, then the null hypothesis is accepted at the 0.05 (95 per cent) significance level.

19. Calculated $Z = -1.78$; Critical $Z = -1.645$ at the 95 per cent confidence level and a one-tailed (lower tail) test. Hypothesis (Null) - The mean assessed value of property for households with infant deaths is not significantly different than for those households without infant deaths. Since $-1.78 > -1.645$, then the null hypothesis is rejected at the 0.05 (95 per cent) significance level.

20. Spearman's Rank Correlation Coefficient (R_s) = 0.608

Critical value of R_s = 0.506; with n = 12 and 0.05 significance level.

Hypothesis (Null) - There is no correlation between the average assessed value of property and the number of infant deaths at the divisional scale in Lowertown. Since $0.608 > 0.506$, then the null hypothesis is rejected at the 0.05 (95 per cent) significant level.

Chapter Six:

Summary, Conclusions and Future Research

Introduction:

The objective of this final chapter is to summarize the main findings of this thesis and to provide suggested areas for further research that would add to our understanding of infant mortality and the social, economic and housing factors that influenced the health of certain populations in the past. The key findings and conclusions from each of the previous chapters are presented, as are the more general conclusions from the project as a whole. The chapter concludes with a discussion of possible directions for future research on this topic, some of which have been mentioned briefly throughout the text of this thesis while others have emerged from the conclusions made here.

Summary:

In Chapter Two, the objective was to place Ottawa, as a 'turn of the century' city, in the context of the processes of urban and industrial growth of the time. The processes of late nineteenth century urbanization and industrialization, brought on by technological improvements in agriculture and manufacturing as well as increased industrial production, dramatically changed both the rural and urban landscapes of

Europe and North America. Rural families were forced, through unemployment, to migrate in large numbers to the cities in search of the poorly paid jobs that the newly developing industrial plants offered. This led to the over-crowded, unsanitary and generally poor living conditions that have come to characterize the plight of the urban, working poor in Victorian cities. Engels, describing nineteenth century housing writes,

[g]enerally, however, the workers are segregated in separate districts where they struggle through life as best they can out of sight of the more fortunate classes of society ... These little houses of three or four rooms and a kitchen ... are where the working-classes normally live ... Ventilation in the slums is inadequate [since a] great many people live huddled together in a very small area... (Engels, 1958, 33)

Infant mortality rates are often used as proxies for standards of living; the conditions found in these Victorian "slums" have been linked, by many authors, to high rates of infant mortality. The literature suggests that there are three issues that are particularly relevant to the rates of infant death; public health and sanitation, living conditions and fertility. The final section of Chapter Two examined, in detail, the work of three groups of researchers, each studying the living conditions and the infant mortality rate for a different nineteenth century city; Montreal, Hamilton and Adelaide. The work undertaken in these three studies closely resembles this project and so provides good comparisons for this work on Ottawa.

Because this thesis examines the living conditions and the incidence of infant mortality in Ottawa in 1901, it was necessary to study the political, economic and social processes that influenced the development of the city over the course of the

nineteenth century. Chapter Three examined the history of Ottawa from the native uses of the Ottawa River and Chaudiere Falls site, through to the establishment of a British military and commercial outpost with the construction of the Rideau Canal and the development of the lumber industry in the Ottawa Valley. The land acquisition policies of these early settlement years along with construction of the canal, the lumber industry and the establishment of Ottawa as the capital of Canada all contributed to the development of Ottawa as a divided city in 1901. Each of the different regions of the city of Ottawa (Lowertown, Uppertown, Sandy Hill and LeBreton) were shown to be distinct from one another. More specifically, a detailed examination of ethnicity, religion, language, housing and population density demonstrated that Lowertown was unique from the rest of Ottawa with respect to these common indicators of the quality of the living environment. A clearer understanding of the unique social community of Lowertown with its poorer quality housing and generally worse living conditions was a key part of this chapter.

The objectives of Chapter Four were two-fold. The first objective was to demonstrate that the distribution of infant deaths in Ottawa in 1901 was similar to the pattern of social, economic and housing conditions described in the previous chapters. The generally poorer living conditions found in Lowertown led to the expectation that infants would be more likely to die in this district. Analyses of the data collected showed this to be the case. The pattern was clear; Lowertown was home to substantially more infant deaths than the rest of Ottawa's regions. The second objective of Chapter Four was to ascertain which causes of infant death were the most

prevalent in Ottawa as a whole and in Lowertown in particular. The literature suggests that many of the most prominent illnesses of the young in the late nineteenth century were related to environmental conditions. Sources of illness often stemmed from poor living conditions and a generally low standard of living, as well as poor sanitary services and nutrition, although these latter two components were not directly addressed in this thesis. For Ottawa, and Lowertown in particular, it was these environmental illnesses that were the most prominent. The fact that these environmental illnesses were more prevalent in Lowertown suggests that the living conditions there may have been worse than for the rest of the city. Further evidence of poor environmental conditions in Lowertown was provided by analyses of the seasonality of disease and infant death. The summer season, when poor living conditions became worse due to extreme heat, poor ventilation and a lack of fresh water, caused many more infant deaths to occur, particularly in Lowertown.

The final chapter, Chapter Five, established that unlike the clear geographical pattern of infant mortality that existed for the city as a whole, the clustering of infant deaths onto a few particular block-faces within Lowertown was not marked. Beyond this analysis of the geographical pattern of infant death in Lowertown the work presented in Chapter Five showed which social, economic and housing factors were most associated with infant death. Among the social factors, ethnicity, religion and language were all found to be related to the incidence of infant death. Specifically, households of French ethnicity, Roman Catholic faith and French-speaking had higher rates of infant deaths than others. Literacy, in Lowertown, was not found to have a

significant association with infant deaths, despite evidence to the contrary in the literature for other cities at this time.

With respect to housing conditions, several factors appeared to be associated with higher rates of infant death. Both external and internal housing density, or crowding, were important. External density, as measured by population per acre and population per block-face, and internal crowding, as measured by person per room, were all found to be positively related to the incidence of infant mortality. This means that as crowding or density increased, so too did the rate of infant death. House type was also important. The incidence of infant mortality was much higher in those houses constructed of wood and much lower in those constructed of stone and brick. Similarly, smaller houses, as measured by the number of rooms, had much higher rates of infant death than did medium or large sized homes. Finally, the size of family or number of residents in each household was found to be significantly associated with infant deaths. Those homes with large families or a high number of residents had much higher rates of infant death than did the smaller families. The significance of each of these factors contributes to the already large literature which suggests that housing conditions were important in the healthiness of urban living. Clearly, the generally poor housing conditions that existed in most of Lowertown had an effect on the number of infant deaths there.

Finally, the economic factor determined to be the most closely associated with infant deaths was assessed value of land and property. At the divisional level, the data revealed that as average assessed value of property increased the number of infant

deaths decreased. Other economic factors such as income and occupation were evaluated but due to the unreliability of this data the results obtained were considered to be unreliable.

In sum, Lowertown was distinctly different from the rest of Ottawa with respect to the socio-economic living conditions found in the district. The citizens of Lowertown seem to have lived in conditions that were much worse than those found elsewhere in the city. Moreover, the distribution of infant deaths corresponded to this pattern of poor living conditions, with Lowertown having a greater share of the infant deaths than other areas. The living conditions for the city as a whole, but particularly for Lowertown, were such that the most prominent causes of death were environmental in nature, in that the sources of these illnesses were most likely the result of poor sanitation, nutrition, housing and low general standards of living. Analyses of the causes of death as well as the seasonality of death confirm this.

Finally, a marked pattern of geographic concentration did not exist for the infant deaths within Lowertown while, on the other hand, specific social, housing and economic factors were shown to be associated with these deaths. Particular block-faces and districts of Lowertown were slightly more likely to have infant deaths than others, but no evidence exists to suggest any physical differences between these block-faces, or the houses on them, and the others nearby. Differences between households and neighbourhoods in terms of social, economic and housing conditions were the source of the difference between the households with infant deaths and those without. Ethnicity, religion and language were the social factors found to be associated with

infant death. House type and size, family or household size, internal crowding and external population density were factors of housing conditions found to be associated with infant mortality. Finally, assessed value of property and to a lesser degree, income and occupation, were the economic factors associated with infant mortality. The location of a house itself is not the key to infant mortality; this thesis has shown that factors internal to the home were most strongly related to infant death.

Evidently, Lowertown was home to a disproportionate number of infant deaths and the living conditions there were substantially different from those in the rest of the city. Moreover, more infant deaths, a higher proportion of deaths from environmentally related illnesses such as cholera, enteritis, asthenia, debility, marasmus and diarrhoea and a more pronounced seasonality of death all demonstrate the poorer standard of living that existed in Lowertown. Socially, families of French, Catholic and French-speaking backgrounds were more susceptible, perhaps because language barriers had a negative effect on their earning potential and contributed to their poor living conditions. Similarly, large families living in small wooden houses had the highest incidence of infant death. These crowded conditions, surely necessitated by poverty rather than choice, likely contributed to the spread of illness. They also reflect other characteristics of poverty such as the inability to buy adequate quality and quantity of food and medical care when necessary. The negative link between assessed value of property and infant deaths suggests further proof of the impact of poverty. The neighbourhoods with the lowest assessed value had the highest number of infant deaths. The important point here is not the impact that assessed

value has on infant deaths, but on what a low value of assessed property means. The land had low market value because of the joint effects of location and the quality of the property and the functions within. In general, what this thesis has identified is that poverty, as represented by the factors identified herein, is a determining factor in infant deaths. The various analyses presented in this thesis all point to the areas, houses, occupations and people living in poverty.

Further Research:

Like most projects, this study of infant mortality in turn of the century Ottawa seems to have raised more questions than it has answered. This is clearly one step in a series of studies required in order to develop a better understanding of the processes influencing infant mortality in Ottawa during this time period. Throughout this thesis several areas of further research have been suggested, but they require re-iteration here. Infant deaths in institutions such as orphanages and foundling homes account for a large proportion of the deaths in Ottawa and elsewhere in Canada and further investigation into records of these institutions may produce a better understanding of the reasons for these high numbers. Also, causes of death and the diagnostic ability of "turn of the century" doctors require further investigation. Examination of the specific sources or causes of illness that result in infant deaths, such as stillbirth, marasmus, enteritis and diarrhoea, would contribute a great deal to the understanding of the processes causing infant mortality. In other words, more attention to the causation of

infant mortality is warranted. Similarly, the link between physician provided care and infant deaths is largely under-studied. For instance, the role of midwives and doctors in child-birth, and nurses, doctors, aid-workers and so on in the provision of neonatal and post-neonatal care is largely unknown.

This thesis has contributed to the understanding of which social, economic and housing factors were associated with infant death in Ottawa in 1901. Although 1901 provided a convenient point to study this problem for the reasons mentioned previously, it remains unclear, however, how 'typical' this year was in this era. Therefore, a temporal analysis of how the infant mortality rate for Ottawa, and particularly Lowertown, changed over the period of the late nineteenth century to the early decades of the twentieth century is warranted. A determination of when the mortality rates began to decline would assist in substantiating the preliminary conclusions made in this project. More specifically, a temporal element may help to further our understanding of the relevance of location to infant mortality. If the cases of infant death were highly mobile from one year to another, then the significance of location would be further reduced.

Furthermore, the locational, social, economic and housing factors studied in this thesis were examined in isolation from one another. This limits somewhat the conclusions that can be drawn from this study. A logit regression analysis would allow for any inter-relationships between these factors to be exposed as well as allow for the most important factors contributing to infant mortality to be determined. Any further research on this topic should undertake this type of analysis.

Perhaps most importantly, a study of qualitative sources such as newspapers, city council records, church and cemetery records, diaries and personal notes and records of key physicians, midwives, city councillors and public health officials would aid in the understanding of infant mortality. It still remains unclear how aware people were at the time of the infant mortality problem in Ottawa and what actions were undertaken to remedy it. Important information could be garnered from analyses of the actions of philanthropic organizations, the municipal government and the provincial board of health; the impact of these actions in reducing the infant mortality rates in Lowertown could be assessed. For example, what impact did the construction of sewers or the provision of fresh water or the pasteurization of milk or the introduction of charitable organizations aiding the poor and sick have on the incidence of infant mortality in Ottawa?

In 1901 Ottawa, the residents of Lowertown lived both in the city's poorest conditions and experienced the city's greatest proportion of infant deaths. This thesis has shown that the poor, French families who lived in Lowertown were the most likely to have infant children die before their first birthdays. Clearly, a connection existed between Lowertown's rate of infant mortality and the social, economic and housing conditions that characterized the area at the time. This relationship between infant mortality and living conditions has been well-documented in the literature on infant mortality and this study has demonstrated that the connection between these two variables also existed in "turn of the century" Ottawa.

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