INFANT MORTALITY DURING THE GREAT DEPRESSION IN HAMILTON

INFANT MORTALITY DURING THE GREAT DEPRESSION IN HAMILTON, ONTARIO (1925-35): TRENDS, CAUSES, AND IMPLICATIONS

By

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ABSTRACT

Existing historical research on population health in Hamilton, Ontario concentrates on the past 60 years and the beginning of the twentieth century, leaving an unexplored gap between 1919 and the 1950s. Additionally, few health studies focus on the impacts of economic levels on child and infant wellbeing particularly in the early 1900s.

This thesis investigates the impact of the economic effects of the Great Depression on human health through the study of infant mortality in Hamilton, Ontario between 1925-35. Aggregate patterns of temporal, spatial, and seasonal infant mortality are examined in detail in addition to cause-specific mortality based on individual-level data obtained from death certificates. The three aims of this research are to: 1) explore and compare infant mortality trends before and during the Great Depression; 2) determine how the economy affected infant health, and; 3) determine whether these effects were experienced equally across socio-economic strata.

An overall decline in the number and rate of infant deaths was found during the years of the Great Depression, however the working-class immigrant population was found to disproportionately contribute to the municipal infant mortality rates during these years. A review of local history suggests that the efforts of the public health department and the effects of a housing boom in the 1920s created conditions that buffered most infants from the detrimental effects of the economic crisis. The differences in the IMRs between the affluent and impoverished neighbourhoods reflect the underlying economic and political forces responsible for the social segregation in Hamilton.

The findings of this study contribute to the field of anthropology as the effects of the economy on human health are explored through the urban experience of immigrant and local populations. Future research should focus on individual-level analyses and the effects of economic conditions on maternal and fetal health.

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CHAPTER I

INTRODUCTION

The destruction of the poor is their poverty. The rich baby lives–the poor baby dies. (Dr. Helen MacMurchy 1911:5)

The association between social inequality and health has been documented as early as the nineteenth century, if not earlier. One of the ways in which this inequality was physically manifested was through the difference between the survivorship of infants. Infant mortality is considered to be the most sensitive indicator of the health of a population as infant death is either directly or indirectly attributed to environmental and social factors (Rosen, 1958). It is typically expressed as a rate called the Infant Mortality Rate (IMR), which is the number of infant deaths per 1,000 live births per year. This measure is considered to be a good indicator of the overall state of economic and social development (Richardus et al. 1998:55) as well as the overall health of a community. In places where poverty prevails, IMRs are highest and thus must be studied in detail to determine what specific conditions, besides the general lack of access to resources, are causing these detrimental effects.

The generalized nature of national, provincial and municipal mortality reports available in Canada, which also holds true for other countries, can disguise inequalities in socioeconomic conditions that may have given rise to variations in infant mortality within and between cities. In fact, Reher et al. (1997) emphasize the heterogeneity of mortality data and urge that this must be considered when undertaking temporal demographic studies (52). Comacchio (1993) quoted Charles Webster stating that "the average [IMR] understates the advances in health enjoyed by some sections of the community, and it overstates the position with respect to a substantial minority" (36). It is therefore imperative to consider class differences in infant mortality because, unlike the middle- and upper-classes, the poor do not have equal access to resources and are thus more prone to poor health, disease, and premature death.

In contrast, Kunitz (2007) argues that although social status has been associated with health disparities, it is more so the *place* of residence that can better predict mortality (78). Numerous studies of spatial variation in infant mortality, mostly in European countries, have been undertaken (Woods 1984a; Vuorinen 1987; Kintner 1988; Williams 1992; Reher et al. 1997; Mercier 2003). The conclusions of these studies all indicate that during the nineteenth- and early twentieth-century higher infant death rates persisted in urban environments in comparison to rural, particularly in heavy industrial centres (Reid 1997:151). In addition to regional variations, community-level analyses of cities highlight differential infant mortality rates between neighbourhoods (Gagan 1981; Woods and Woodward 1984; Reid 1997; Harris and Mercier 2005). The causes of these variations, however, are not constant and can be attributable to a complex interaction of many factors. The way in which these factors interact and the pressures they exert on individuals, affecting their health and mortality, is not by any means predictable as it greatly varies based on local and historic contexts (Kunitz 2007). This thesis investigates population health in the city of Hamilton, Ontario in these contexts.

As an industrial city of great importance to the national economy, the health of the ethnically and socially diverse population of Hamilton has been studied over the years.

Many contemporary studies have been concerned with the effects of pollution on human health due to the heavy industrialization of the city's north end, but the timeframe of these studies does not go back earlier than the 1950s. Historic research has been much more limited. The greatest contribution to the understanding of the health conditions across the city of Hamilton is research conducted by Gagan (1981). She focused her investigation on the health conditions and mortality from 1900 to 1914 in the context of the emerging Department of Health. Her results indicated that infant mortality in Hamilton was higher than the provincial and national average at the time, which she attributed to the disparity in economic and social factors. Three other substantial contributions have been made. Two of these focus on illness and infectious disease in early twentieth century Hamilton (tuberculosis 1904-05 (Herring 2007) and the 1918 influenza pandemic (Herring 2005)) with limited discussion of disease among children. The third is a volume dedicated to the specific examination of childhood health and illness, but similarly, it covers the time period 1900-1917 (Herring 2008). Aside from municipal public health reports, no research has been published on the health of Hamilton's population between 1919 to the 1950s.

All of these studies expose the problem of inequality and health differentials between the immigrant and the well-established local populations. The goal of this thesis is to address issues related to social class and ethnicity through an examination of infant mortality in Hamilton, Ontario before and during the Great Depression (1925-1935). Through my investigation, I aim to answer the following questions:

1) What were the trends and causes of infant mortality in Hamilton, Ontario before and during the economic crisis of the Great Depression?
2) How did this economic crisis affect the health of Hamilton's population?
3) Were all infants in Hamilton affected equally?

As I explore these questions, I pay particular attention to the social stratification of certain neighbourhoods within Hamilton to determine if, as indicated by previous research, these communities were more susceptible to death and disease during the Great Depression, and if patterns of infant mortality were consistent across time and space.

By demonstrating that the labouring class is most vulnerable in times of economic crisis, this research provides valuable insight into the conditions of the state of Hamilton's healthcare, social welfare, and relief programs during some of the most trying times in Canadian history. Additionally, this research can help predict potential impacts of current economic conditions on the health of Canadians across multiple socioeconomic strata.

Theoretical Framework

The investigation of the issues presented in this thesis follows the theoretical approach of critical medical anthropology. This framework focuses on the ways in which political and economic structures shape inequalities in health, health care, disease, and the experience of illness (Singer and Baer 1995). This approach addresses the social origins of disease through careful observation of class, ethnicity, and gender, and the "day-to-day living and working conditions of sufferers" (Singer 2001:107-108). Access to resources, and therefore the health of a population, is determined by an interaction of economic and political forces, which are exerted on a micro- and macro-level. Critical medical anthropology parallels certain views of the pessimistic approach of the New Social Medicine (Kunitz 2007), which perceives the impoverished individual as a victim. The risk factors associated with this type of victimization are created by social and economic forces and, amongst many, include poverty, disparity in income and socio-economic status. The "degree that the poor are able to exercise choice…[is] tightly constrained by the limits imposed upon them by poverty and social exclusion" (Kunitz 2007:22). It is thus through the combined lens of these two frameworks that I approach the examination of the impact of the economic crisis of the Great Depression on infant health in Hamilton.

Thesis Outline

I have organized this thesis into five chapters. Chapter 2 provides a background on the social, demographic, and economic structure of Hamilton until 1935. The chapter also outlines the global and local patterns of infant mortality throughout the nineteenth and early twentieth centuries, and explains the effects of economic production on infant mortality.

Chapter 3 provides a discussion and analysis of the quality of archival materials used for this research and includes a description of the methods used to study patterns of infant death. Although somewhat limiting, registered death certificates have proven to be a rich source of information at the individual level. The quality and accuracy of the information is assessed and is considered acceptable to use in this study.

Chapter 4 presents the results of the quantitative analyses used to examine infant mortality. The findings indicate that infant mortality in Hamilton was slightly lower than the overall national rates; however differences between neighbourhoods and by socio-economic status were observed.

The discussion of these results within the local and theoretical contexts is presented in Chapter 5. It centers around how the complex interaction of economic and political factors has predisposed immigrants and labouring class citizens in Hamilton to deplorable living conditions and resulted in poorer health outcomes in comparison to more affluent citizens. Suggestions for future directions in studying infant mortality and population health are provided.

CHAPTER II

HAMILTON: HISTORY OF ECONOMY, PEOPLE AND INFANT HEALTH

It is important to frame the discussion of infant mortality and the Great Depression within the local context of Hamilton, Ontario. This chapter begins with an outline of the historical background of the city of Hamilton and its people. It includes a discussion of Canada in the Great Depression and how Hamilton as a city was affected by it. I then turn to an explanation of how global trends in infant mortality have changed over the nineteenth and twentieth centuries and focus on the effects of economic crises on infant mortality. The chapter concludes with a history of public health initiatives aimed at reducing infant mortality rates in Canada and Hamilton.

The information on the history of Hamilton, its public health department and infant care were obtained from numerous sources including archival newspaper articles, published municipal and national reports, as well as other secondary sources. It must be noted that although biases exist in these materials, the use of numerous sources increases the likelihood that a reasonably complete brief history can be provided here.

History of a City, 1812-1935

Hamilton's history dates back to its modest beginnings in 1812. Back then it was no more than a small plot of land located at the westernmost shores of Lake Ontario. The city's founder, George Hamilton, had no way of knowing at the time that this location was one of the key factors responsible for turning Hamilton into one of the of the most lucrative industrial cities in Canada over the next century (Bailey 1981) (Figures 2.1 and

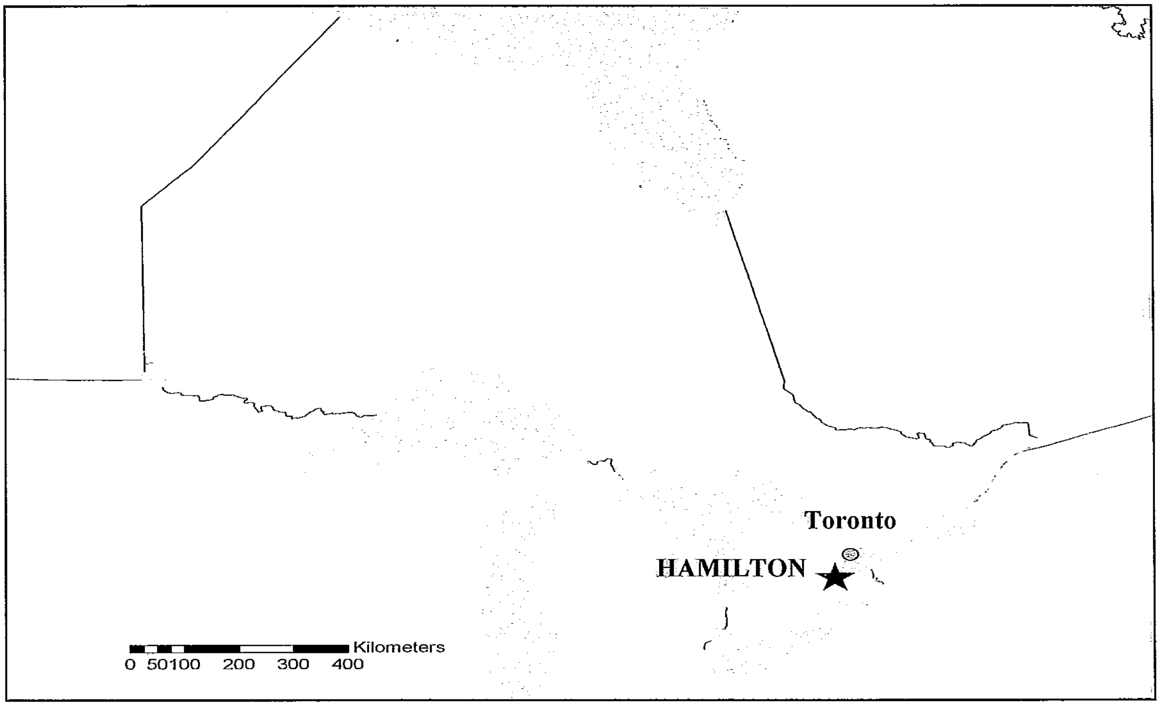


Figure 2.1 Province of Ontario showing Hamilton (star) in Relation to Toronto (dot).
Source: Janjua 2009a

2.2). The government-sponsored marketing of land in York, United Kingdom resulted in the first wave of European settlers moving to the city (Weaver 1982:45). As the population increased, Hamilton grew first into a town in 1833 and then a city, officially recognized in 1846 (Henley 1995).

The city's location gave it an economic edge over the neighbouring towns. Its prosperity began in its role as a commercial hub and trading centre for the shipping industry in Western Lake Ontario (Sproule-Jones 1988:1). With the addition of a railway terminal in 1854 joining the Canadian Great Western Railway with American rail lines

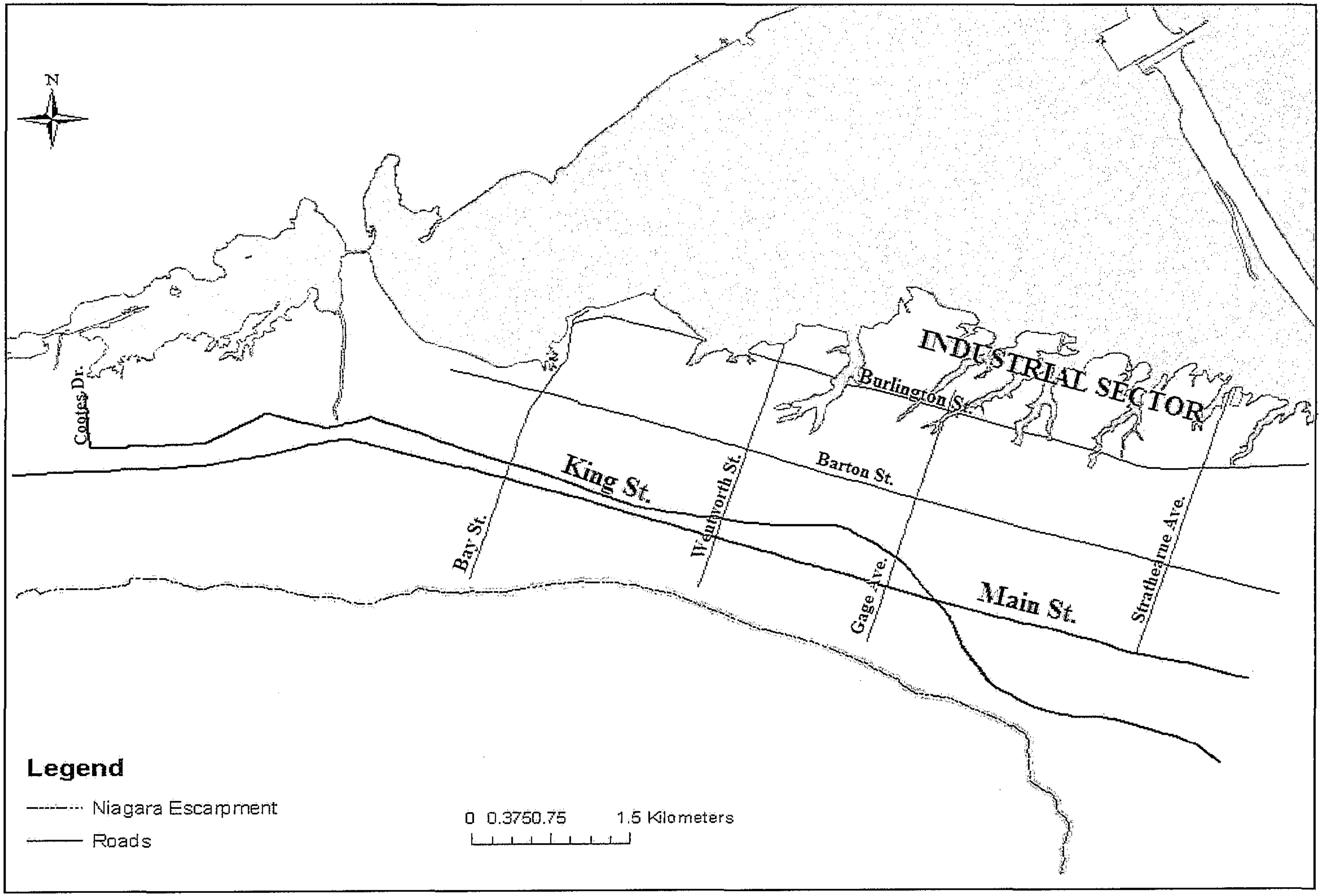


Figure 2.2 City Map of Hamilton, Ontario.

Source: Janjua 2009b

running through New York City (Rowe 2008:9), Hamilton further secured its economic importance and opened up its doors to hundreds of thousands of immigrants. Labourers were needed to construct the railway itself, which attracted immigrants to settle in the area. Upon its completion, Hamilton became the major connection for immigrant travel from ship to rail, an important stop *en route* to their final destinations in the eastern United States (Bailey 1981). The city thus turned into an immigrant centre where its economic growth was mirrored by the growth of its population.

The influx of mainly British labourers came to fill the manufacturing positions resulting in an increase in Hamilton's population from 10,300 in 1852 to 52,655 in 1901 (Wells 1970; The Hamilton Spectator, 28 September 1921) (Figure 2.3). The twentieth

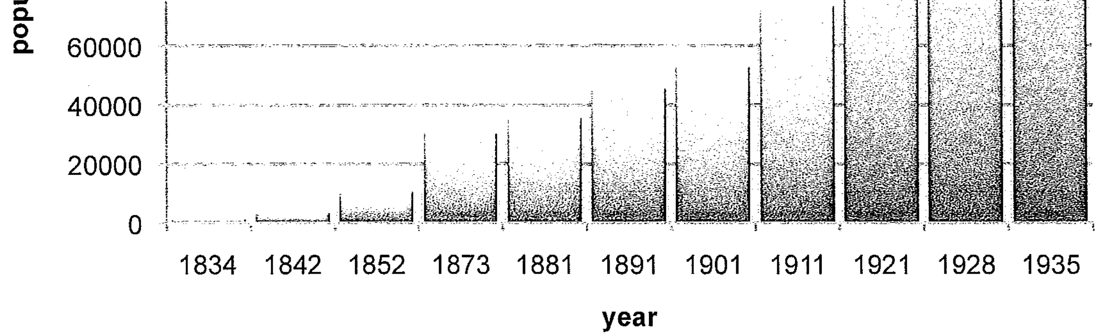


Figure 2.3 City Population, Hamilton 1834-1935.

Source: The Hamilton Spectator, 28 September 1921; Hamilton Assessment Department 1929, 1936; Wells 1970; Rowe 2008.

century saw continued growth; however the ethnic makeup of the city had begun to change (Table 2.1). The immigration patterns in the early 1900s shifted from British newcomers to immigrants of Eastern European, mostly from Poland and Ukraine, as well as Italians and others (Hamilton Folk Arts Council 1978) (Figure 2.4). Most who came had "friends and relatives who had preceded them to Canada" (The Hamilton Spectator, 18 March 1913), and by the 1920s "[t]he majority of the newcomers consisted of women…[who] came out to join their husbands, bringing the youngsters with them" (The Hamilton Spectator, 28 March 1925). By 1935, the city's population rose to 154,022 (Hamilton Assessment Department 1936).

The inequality between the rich and poor in Hamilton is deeply rooted in international and local politics and industry. Access to both water and land transport lured American investors to Hamilton, resulting in the founding of the steel and manufacturing industry (Doucet and Weaver 1991:91). By 1880, "Hamilton overtook Montreal as the

Table 2.1 Ten Largest Ethnic Groups in Hamilton, Ontario by Country of Birth, 1931.

Country of Birth	**Number of People**
Canada	94,580
England and Wales	27,947
Scotland	12,237
United States	3,995
Poland	3,596
Ireland	2,497
Italy	2,433
Hungary	1,626
Russia	891
Roumania	866
TOTAL POPULATION	**155,547**

Source: Census of Canada, 1931

Figure 2.4 Czechoslovakian family selling bread, Hamilton 1920s.

Source: McMaster University, Labour Studies Collection

steel capital of Canada" (Evans 1970:177). The continued growth of the steel industry was guaranteed by not only the city's prime location "in the heartland of Canada" (Evans 1970:180), but was aided considerably by the tax exemptions, bonuses and even free land secured through city by-laws. The burden of paying the difference in taxes owed to the city fell on the people of Hamilton (Freeman and Hewitt 1979:19-22).

Immigrants, who had become "the backbone of the city's economy" (Evans 1970:181), were the ones who suffered most. Not only was there an increase in poverty after 1890 due to the heavy industry that took precedence over the wellbeing of their hard-working employees, but there were many accounts of mistreatment of the foreigners who comprised the working-class. An article published in The Hamilton Spectator included a report of a British labourer, who:

> ...contended that the chances for the improvement of the pecuniary position of a man coming from England to Canada was absolutely false – that better conditions of labor (sic) existed there, that the laboring (sic) man was better organized, and that in fact he was treated by his employer less like a dog and more like a man, and that there was a prejudice on the part of the Canadian against the Englishman. (20 November 1907)

Clearly, the welfare of the workers was never at the forefront, only profit for the wealthy and powerful. "[T]he motto of many of the employers [was] 'to get at and get the best of their men'" (The Hamilton Spectator, 20 November 1907). The system set in place for the incoming immigrant workers seemed to work against them. The monthly payout given to the labourers was guaranteed, but it was necessary to first pay for food and shelter to live and labour through that month. If men did not have the resources to assure these necessities for themselves when they arrived, they would simply not last (The Hamilton Spectator, 20 November 1907).

Those who could afford board did not fare much better. The working-class immigrants crowded in the vicinity of the factories and railway in the city's north and east end (Davey and Doucet 1975:337) (Figure 2.5). Not surprisingly, deteriorating housing conditions were prominent in these parts of town, reflecting the equally poor health conditions of this population (Gagan 1981). In 1921, the Medical Officer of Health, Dr. James Roberts, commented that "[p]ractically no houses worthy of occupation were available for the needs of people with slender incomes in any part of the city" (The Hamilton Herald, 28 April 1921). Unfortunately these were the conditions of working-

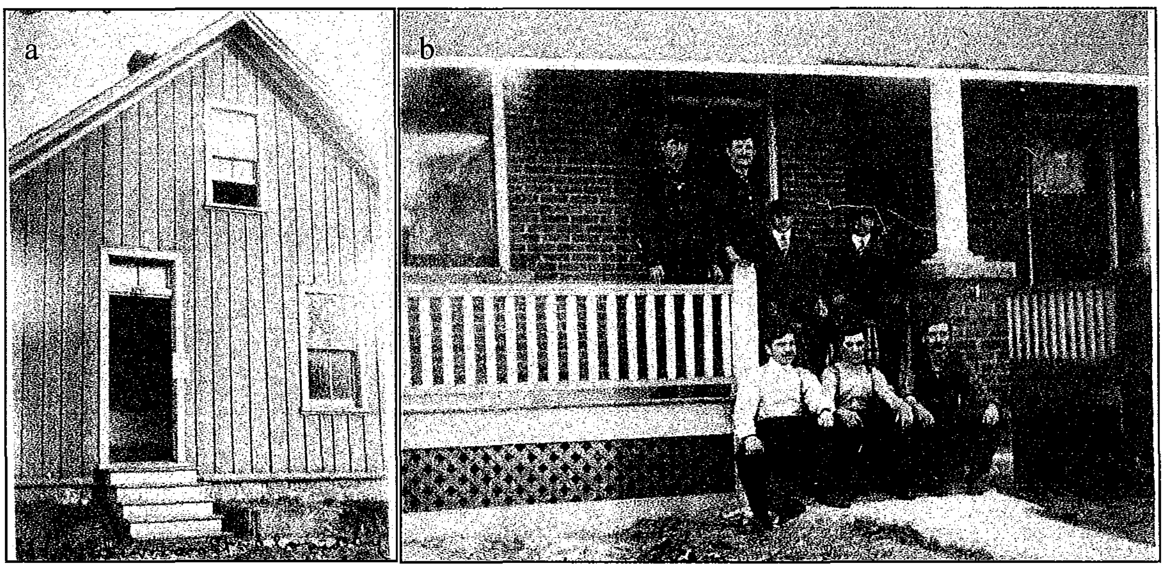


Figure 2.5 Poor Housing in Hamilton. a. A house in the north end closed by the Hamilton Health Department due to unsanitary living conditions (no date); b. Bulgarian lodging house in the north end with thirteen beds occupied by twenty-three labourers, pre-1930s.
Source: McMaster University, Labour Studies Collection.

class families and labourers at the best of times, yet conditions would further deteriorate in times of economic downturn.

Canada and Hamilton in the Great Depression

Over the course of history, Hamilton has had its share of economic ups and downs. The most severe recessions in Hamilton occurred in the late 1850s (Rowe 2008; Weaver 1982), 1914-15 (Doucet and Weaver 1991) and after the end of World War I, 1919-21 (Evans 1970); yet none could rival the Great Depression. Regardless of its severity and the global context, with each depression came poverty mostly affecting the working class. With the decrease in industrial productivity came layoffs and unemployment; this is when "large numbers of people were faced with destitution" (Freeman and Hewitt 1979:22). Over the years, many families were left to fend for themselves and were offered marginal financial assistance only after all their other resources were completely drained (Freeman and Hewitt 1979:22). Despite the clear need, social welfare relief was not institutionalized on a large scale until the Great Depression. When the market crash of 1929 occurred, many working-class Hamiltonians did not fear much loss because they generally did not hold investments (Evans 1970:189-90). But was their lack of concern soundly grounded?

The evidence looks grim and suggests that there should have been cause for more concern. After the United States, Canada was one of the countries most affected by the depression and, along with Belgium, Czechoslovakia, France and USA, is considered to have had a "severe depression experience" (Hill 1988:35, 41, 43). The depression seemed particularly worse in Canada because it fell on the heels of the economic boom of the 1920s (Horn 1972:2). National unemployment rates were some of the highest globally and remained at those levels for most of the decade. Furthermore, industrial production rates declined severely in Canada. The lowest levels occurred in 1933 and did not return to normal levels until 1938 (Horn 1972:1; Hill 1988:40-41). The end of the Depression came with the beginning of World War II.

The burdens of the Depression in Canada were unequally distributed among regions and its people. Unemployment among wage-earners had its lowest levels in "managerial, professional and commercial-financial occupations and in government and education,…it was heavier in transportation, manufacturing and merchandizing, and…it was heaviest in the building trades and export industries, mining excepted" (Horn 1972:11). The industries most affected by the depression were farming and fishing and the hardest-hit provinces were Saskatchewan, Alberta and Manitoba. The increase of tariffs, a coping mechanism created by the Dominion with hopes of stimulating the national market, did offer some protection for industry located in Ontario and Quebec but exacerbated the problems of export (Horn 1972:7). The steel industry was considered to be most vulnerable and relied heavily on export (Horn 1972:88), but the limited attempt at protection was not enough to keep Hamilton from feeling the economic sting.

The Great Depression came to Hamilton with full force. Weaver and March (1982) reported that Hamilton was very "susceptible to the economic downswing" because of its widespread manufacture and international trade of steel (1-2). Production was drastically cut. A large proportion of Hamilton's workforce was laid off. Forty-six percent of the city's workforce was employed either in the manufacturing sector or performed unskilled labour (Weaver and March 1982:2). In 1929 40,632 workers were employed; by mid-year 1933 only 21,800 still had jobs (Evans 1970:190). The ones who were lucky enough to still be working had no reason to celebrate; most were working only part-time for drastically cut wages (Evans 1970:190; Campbell 1966:223). In 1933, almost 9,000 families in Hamilton had received welfare assistance (Figure 2.6). The Dominion government made it its mission to ensure that enough social assistance was given to "prevent anyone from actually starving to death" (Horn 1972:4-5). The debt incurred from this attempt rested on the shoulders of provinces and municipalities, however at the individual level, the burden of taxes unequally weighed on the poor rather than the well-off (Horn 1972:5, 9).

The relief offered to people was filled with inequity and political control. Even though it was designed to help those most in need, the least affected by the economic downturn benefited most. The extremely wealthy had easier access to more loans than the poor in Hamilton; the poor received meager assistance only after consideration of whether they were "deserving and grateful" (Freeman and Hewitt 1979:23). If they were deemed worthy to receive welfare, on top of the stigma already associated with receiving financial assistance, families were under constant surveillance to ensure they were spending their money 'wisely' (Figure 2.7). Those who received medical assistance were even more under the watchful eye of the municipal government as the "authorities had...power to control their entry" into hospitals (The Hamilton Spectator, 9 May 1927).

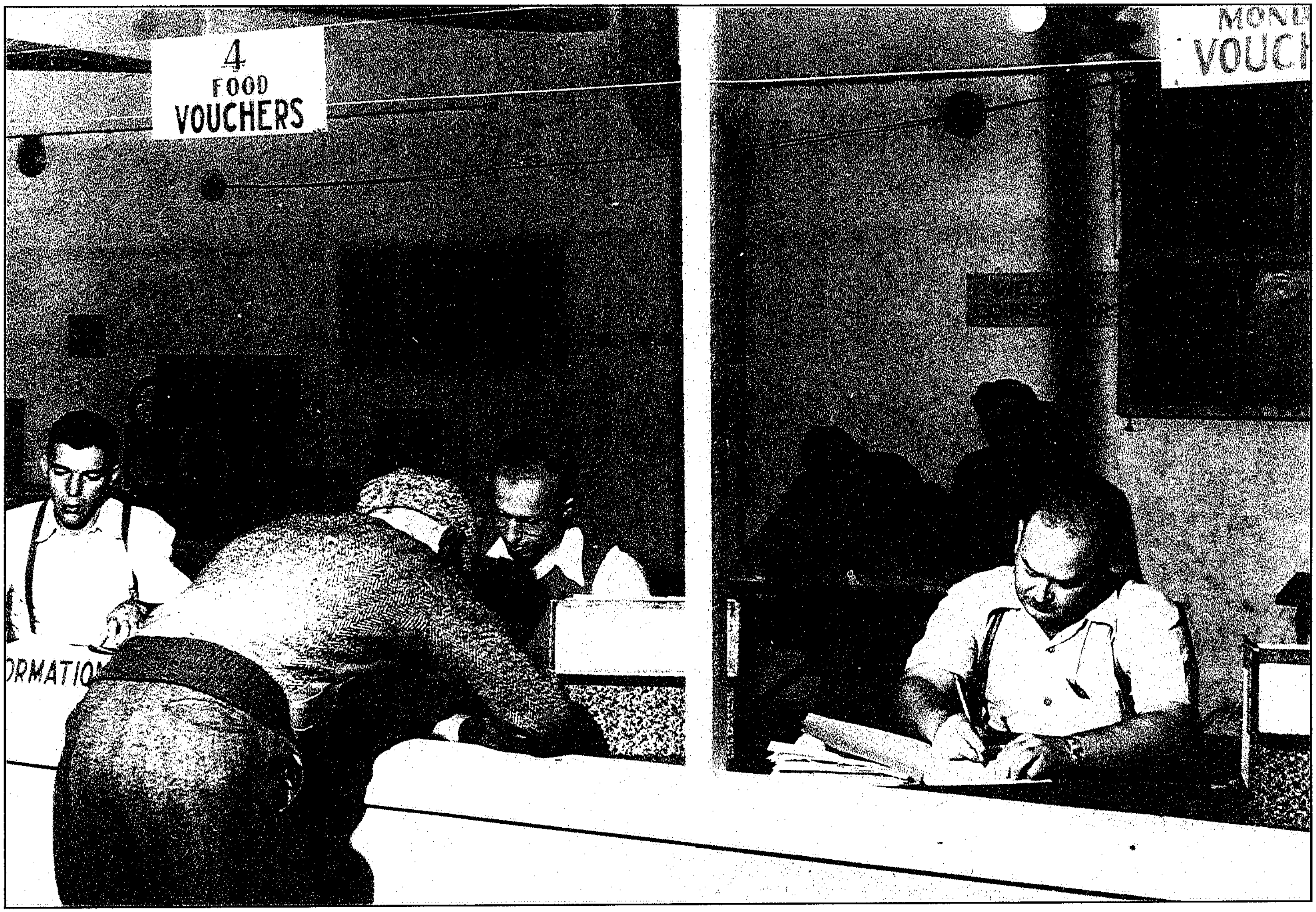


Figure 2.6 Food Voucher Counter at the Welfare Office, City of Hamilton (no date).

Source: McMaster University, Labour Studies Collection

Figure 2.7 Photograph Published in The Spectator. Caption Read, "Depression Days: Down To The Last Cigarette! Brother, Can You Spare A Light?" Hamilton, 1930s.
Source: McMaster University, Labour Studies Collection.

Although the poor undeniably suffered greatly, the experience of the middle-class Canadians cannot pass unnoticed, since for them "the 1930s were probably years of serious *relative* deprivation" (Horn 1972:14, emphasis in original). They were considered the "new poor" (Marsh 1938:4). In most cases these families "lack[ed] experience in living to the best advantage at low economic levels, and, in addition, their mental health [was] seriously jeopardized by the severe crisis through which they [were] struggling to make an adjustment" (Marsh 1938:4). Considering that in Hamilton to qualify for assistance a household must not have had any "unnecessary items[1]" of luxury (Freeman and Hewitt 1979:22), it mush have been considerably more difficult for middle-class families to receive welfare. Families receiving social assistance, however, had to ensure that their dietary needs were met and had to manage to do so with very little income:

> A small sum to spend on food usually means lack of fruit, fresh vegetables, milk and fats. Inadequate footwear and clothing increases the liability to colds and other ailments. Families move to low rent areas or "double up" to economize on rents, resulting in overcrowding, which is one of the worst evils of bad housing so far as physical health is concerned. (Marsh 1938:3-4)

As noted, the living conditions that arose as a result of the Great Depression impacted the health and wellbeing of families. A look into how this was reflected through infant mortality follows.

Infant Mortality Trends and Economic Effects

The staggering number of infant deaths observed in the nineteenth century brought about a conscious effort on the part of public health officials, medical doctors and government officials to improve the social and environmental conditions attributable to such high mortality among infants (Mercier 2003:2). In European countries, the peak in infant mortality rates was observed right before the turn of the century and began its general decline two to three decades before World War I (Woods et al. 1988:348). Similarly, the Canadian government in the early twentieth-century put into practice

[1] Possession of a car was considered a luxury in the 1930s.

policies that resulted in a cross-country reduction in post-neonatal infant mortality rates that continued to the end of the century (Nagnur 1986).

Apparently, Canada was not unique in this endeavor. The crisis of the influenza pandemic after WWI is considered a catalyst for the organization of healthcare systems worldwide responsible for maternal and infant health (Masuy-Stroobant 1997:26). Stillbirth rates in Europe also started to decline during the interwar period with the rise of antenatal clinics, while neonatal mortality did not begin to decline until the 1950s (Masuy-Stroobant 1997:26-27). A "permanent decline in post-neonatal mortality started in the early 1920s" (Masuy-Stroobant 1997:26), but did it continue during the Great Depression?

Meckel (1990) reports that in the United States the infant mortality rate declined from 65.0 deaths per 1,000 live births for "white babies" and 105.4 deaths per 1,000 live births for all other "races" in 1925-29, to 55.2 (for white) and 98.6 (for all other) per 1,000 live births in 1930-34. Data for Europe yields similar trends. Of the 25 countries for which data were available included in Masuy-Stroobant's (1997) study indicate a decline in infant mortality rates between 1926-30 and 1931-35, with the exception of Bulgaria and Yugoslavia, which exhibited an increase of 0.02 and 2.14, respectively (29). Similarly, Pinnelli and Mancini's (1997) study of infant mortality in Italy supports this finding. Their research shows that the infant mortality rate was gradually dropping over the decade between 1926 and 1935 with an increase only between 1935 and 1940.

Analyses of infant mortality during the depression of the 1980s in Brazil revealed a similar trend. Macedo (1984) contends that the decline was attributed to sanitary improvements (increased water quality and supply), as well as investment in health care and access to housing, which started in 1974-78. This investment in infrastructure is believed to have had a greater effect on child and infant health than any effects of an economic depression (Macedo 1984:42). There was, however, an observed increase in low birth weight rates with the onset of the Brazilian depression, which is believed to have been at least partially caused by economic decline (Macedo 1984:44).

Although the mortality trends during the Great Depression suggested a steady decline, several studies have confirmed that infant mortality rates may actually have increased as national economic conditions deteriorated. Separate analyses of neonatal and post-neonatal mortality reveal distinctive patterns, which are thought to be a reflection of the different mechanism through which the forces of economic decline are transmitted (Brenner 1973). Brenner argues that infant mortality has an inverse relationship with unemployment rates, which rise during economic downturns. His findings indicate that fetal mortality increases in the same year that economic conditions decline and perinatal mortality lags approximately by one year. Additionally, MacMahon and Yen (1971) reported an increase in congenital malformations during the Great Depression in the US.

An analysis of post-neonatal mortality by Brenner reveals a pattern of escalating mortality with a three- to five-year lag following the onset of a recession. This several-year lag in post-neonatal mortality is explained through the effects of long-lasting unemployment and decline in socio-economic status, resulting in a lack of financial resources needed to maintain a level of high quality care for infants. Furthermore, Adamchak (1979) studied the economic effects on post-neonatal mortality between 1960 and 1970 in Ohio and concluded that a remarkable increase in the mortality rates among this age group were directly linked to "marital instability, income level and unemployment" (Cornia 1984:26). Clearly, the effects of the economy on infant mortality are not predictable and depend on the interactions of global and local factors. In order to understand this interaction in the context of this project, I turn to a historical review of the local factors that shaped infant mortality in Hamilton.

Infant Mortality in Hamilton

The medical and social healthcare reform that was started in Ontario at the end of the nineteenth century was based on the existing models in Great Britain, France and the United States (Comacchio 1993:17-18). The child welfare campaigns were aimed specifically at decreasing infant mortality, which, according to officials, were mostly caused by prematurity and congenital factors, intestinal infections, and respiratory infections (listed in descending order) (36).

The greatest efforts were put towards eliminating infantile diarrheal diseases in Ontario at beginning of 1900s because they were seen as preventable (Comacchio 1993:37; Hamilton Health Association 1928-29). Gagan's (1981) study of population health in Hamilton reveals that the leading causes of infant deaths did not change over time. After congenital factors, gastrointestinal disease claimed proportionally more infant lives than any other cause between 1900-1914 (93). This, Gagan states, is the reason why health officials and middle-class families concentrated on providing safe, clean milk for infants in Hamilton (126), an effort first initiated in the city in 1909 (Wells 1970).

The infant mortality rates for Hamilton began to slowly decline in 1905, and started to improve dramatically in 1913-14 when pasteurization of milk was initiated in the city (Hamilton Health Association, 1925-26) (Figure 2.8). Although the average reported infant mortality rate for the city looked promising, it was not reflective of conditions in different parts of the city. As noted by Gagan (1981), the working-class wards where deplorable living conditions prevailed yielded the highest infant mortality. This was very apparent to health officials, who commented that "in the foreign section [of town]...infant mortality was alarming [particularly] in the hot summer months" (The Hamilton Spectator, 19 January 1915). The part of Hamilton called the "foreign section" were the two wards located on the northeastern part of town (wards 7-8). Wards 4 to 6,

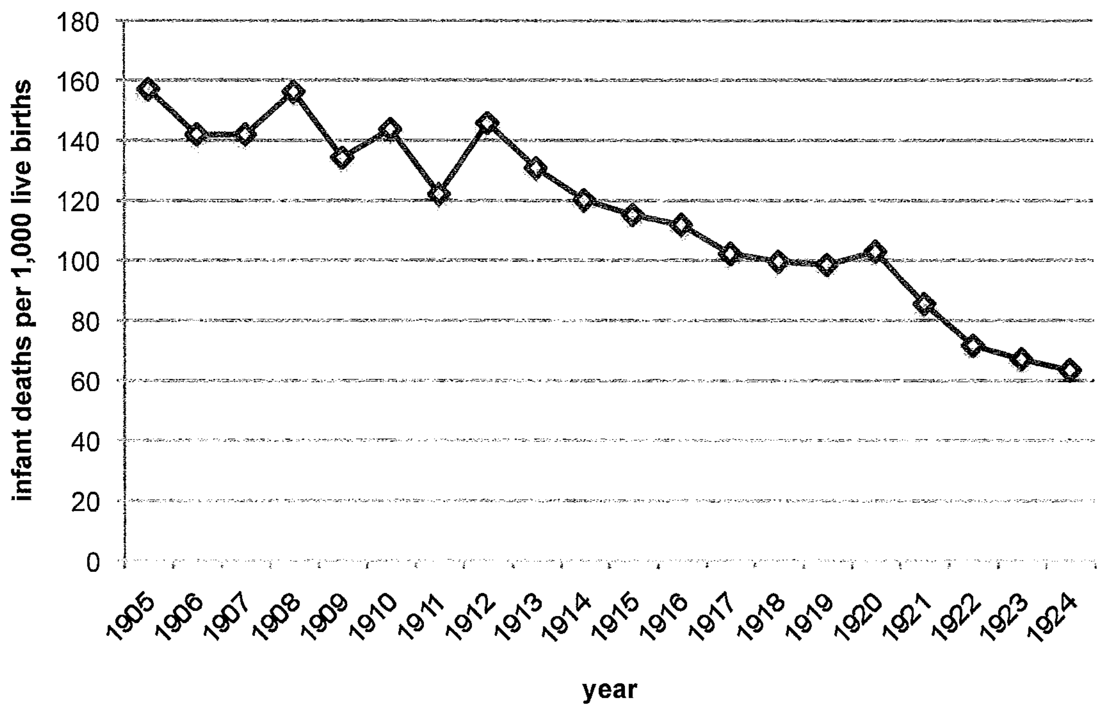


Figure 2.8 Infant Mortality Rate, City of Hamilton 1905-24.
Source: adapted from Hamilton Health Association 1925-26 and Martin 1933.

located along Burlington Bay in the northern section of town, are the wards surrounding the industrial sector and were also home to the working class. The wards located in the southern section of town, wards 1 to 3, were areas where upper class neighbourhoods prevailed (Figure 2.9). The location and social environment of the north and northeastern wards isolated the working class and predisposed them to sub-par living conditions.

The answer to the still unacceptable levels of infant mortality, especially among the poor, was the Babies' Dispensary Guild. Opened in 1911 (Wells 1970), its mission was to become the "institution for the saving of babies, by an educational movement, of how to care for infants" (The Hamilton Times, 15 June 1912). A philanthropic

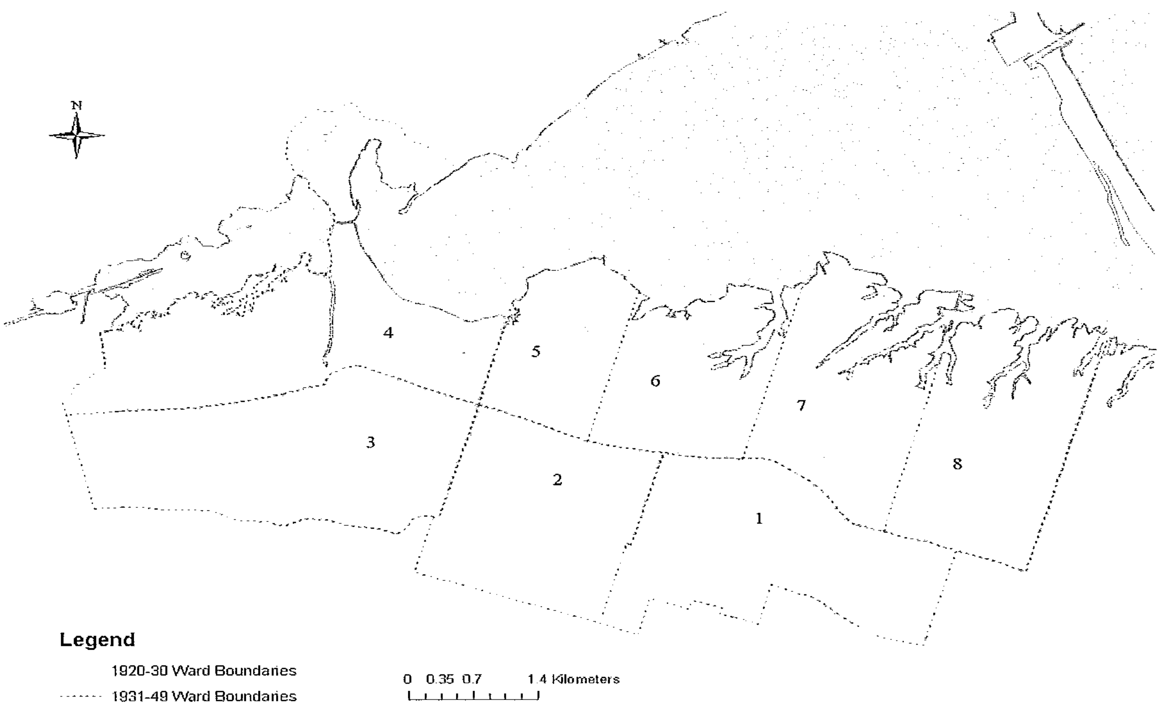


Figure 2.9 City of Hamilton Wards and Boundaries, 1920-49.
Sources: Kirk 1927; McFaul 1930

establishment, in addition to ensuring certified milk to all mothers at less than half the cost, it provided clothing and free milk to families during times of unemployment of the bread-winner (The Hamilton Times, 15 June 1912; The Hamilton Herald, 30 April 1921). Babies were monitored and "weighed regularly, advice [was] given on feeding and rearing in general, [and] lessons on hygiene and practical baby-care [were] taught to the mothers" (The Hamilton Herald, 16 February 1924). Additional care for mothers and their babies was provided through the first pre-natal clinic, which was opened in 1922 (The Hamilton Herald, 16 February 1924) (Figure 2.10).

The approach to infant care at this time can be criticized as patronizing to the mothers. Dr. Helen MacMurchy, a strong public health figure at the forefront of the child welfare movement in Ontario, reported to the Registrar General in 1910 and 1911 that the single most important factor responsible for high infant mortality was lack of breastfeeding. The reasons for choosing not to breastfeed were attributed to the mother's ignorance or inefficiency, a situation that was believed to be solved only through education. Specific instructions for the care of a baby were available to mothers in Dr. MacMurchy's "Baby's Health and Record" book published in the 1920s. Comacchio (1993) notes, however, that this book was biased towards middle-class mothers, as was the entire approach to saving infants.

With increased medicalization of pregnancy and birth (Mitchinson 2002), women were regarded as subjects in the doctors' eyes. They had to listen and follow the instructions of their physician once they became pregnant or gave birth. Education did not take the form of helping women understand and cope with pregnancy; rather it involved

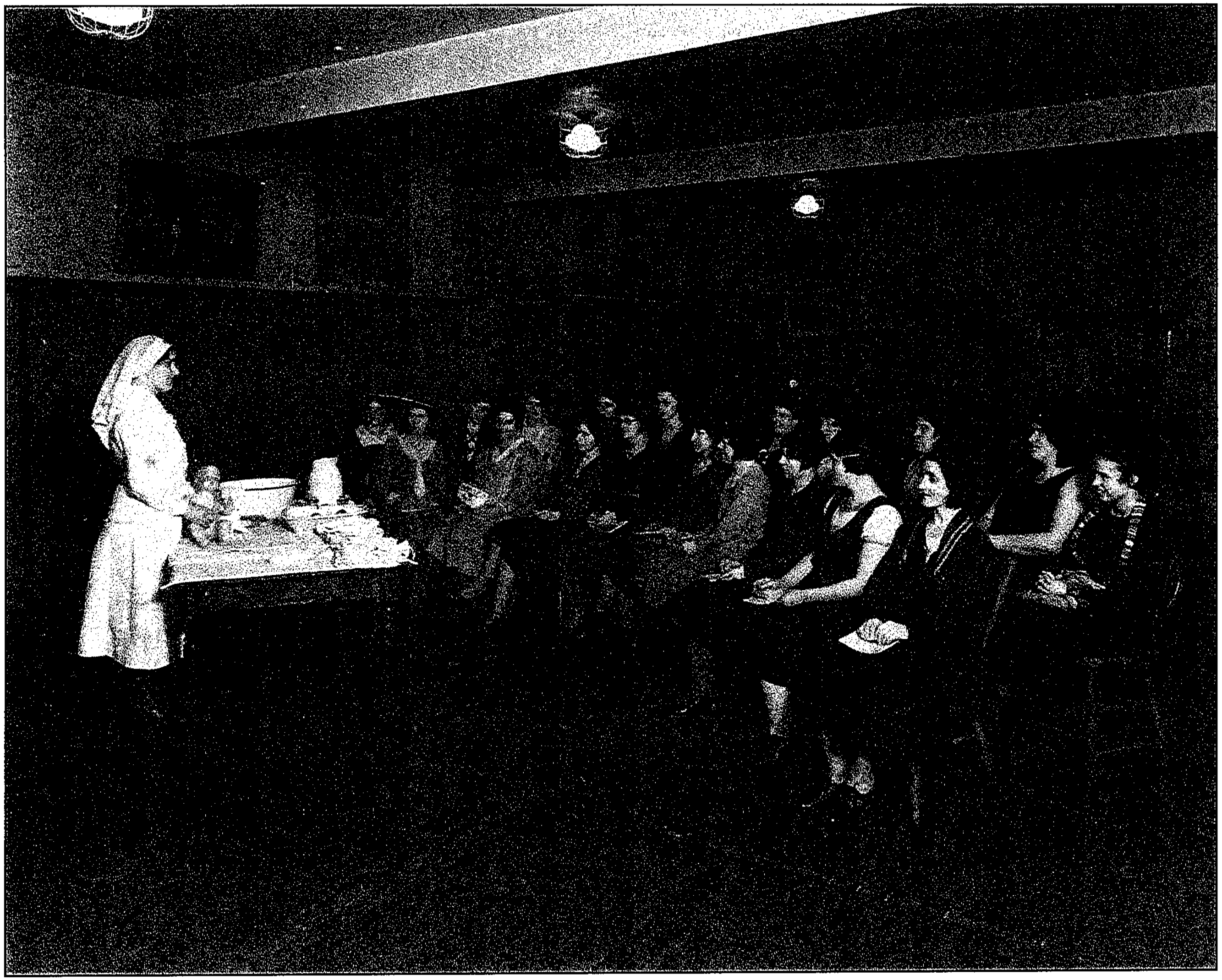


Figure 2.10 Pre-Natal Class at the Mother's Group Meeting, Hamilton 1934.

Source: McMaster University, Labour Studies Collection

"blind faith and compliance" (Comacchio 1993:106-107). Even those who were following the advice from public health literature were blamed if their infants became ill. For example, even if breastfed, if an infant developed diarrhea the condition was blamed on the mother's diet (Members of Baby's Health Association 1928). Furthermore, the association of infant mortality with poverty was clear, but poverty itself was never acknowledged as the source of the observed differences in the health status between babies of the rich and the poor. Instead, the understanding among medical professionals was that the lower classes needed to provide for themselves better food, a cleaner environment and modern medicine; any deviation was understood as a choice based on ignorance rather than lack of opportunity based on poverty (Comacchio 1993:38). Therefore although well intentioned, the system favoured the authority of the physicians;. instead of empowering the impoverished working-class mother, it worked to further rob her of autonomy over her own body and that of her child.

Conclusion

By the early twentieth century, Hamilton had established itself as an economically strong industrial city. Its strategic location attracted investors, commerce and people. The city grew in size at an astounding rate, resulting in an ethnically diverse population. The growing industry brought with it a large immigrant working-class into Hamilton. As more people settled, a clear geographical distinction arose between the middle-class established Hamiltonians and the immigrant labourers. The health conditions, revealed through infant mortality rates, reflected this bias as was well recorded throughout the first quarter of the twentieth century.

As a leader in international export, Hamilton was greatly affected by the Great Depression. Many lost their jobs and slipped into poverty. Based on the historic accounts, one would expect that during this economic crisis the pattern of declining infant mortality in the city would cease and even increase among the working-class, reflecting the declining health and living conditions of the immigrants and others whose livelihoods were suffering. The remainder of this thesis investigates infant mortality between 1925 and 1935 to determine how the global depression of the 1930s impacted people's health in Hamilton, Ontario.

CHAPTER III

MATERIALS & METHODS

Materials

This chapter outlines the materials and inclusion criteria used to create the database for this research. A brief discussion of the history of vital registration in Canada, and possible problems associated with these records, begin the chapter. A description of doctors in Hamilton who played a significant role in the completion of death certificates, particularly pertaining to the cause of death, follows. Primary and secondary sources, including death certificates, annual vital statistics and health reports, newspapers, as well as historical maps are discussed along with the limitations of using these sources in anthropological research.

The methods of analysis, including the criteria used to categorize data, are outlined in the second part of this chapter. They include the quantitative methodologies used to describe the spatial and temporal trends and causes of infant mortality seen in Hamilton. The limitations of each method are discussed. Although imperfect, combining them allows for higher accuracy and confidence in the results presented.

Death Certificates

The registered death certificates for infants and stillbirths for the city of Hamilton constitute the data used for this study (Government of Ontario, 1925-1936). These documents are available on microfilm from the Ontario Archives. Data collection took place in July and August 2008 and information was collected from a total of 3,150 registered deaths for 1925 through 1935 (Table 3.1). To be included in this study, the deceased must have been born and have died in the urban part of the city of Hamilton between the years 1925 and 1935 and must have died before reaching one year of age (365 days for non-leap years, and 366 days for leap years).

Separate databases were created for each year. Information recorded includes: the death registry number and page number (death registry numbers can be duplicated in the same year); name; sex; racial origin, as specified on the death certificate; place of birth; date of birth and date of death; whether the infant was identified as a stillbirth or not; father's name and country of birth; mother's name and country of birth; family street address; cause of death and listed contributory cause of death; and the physician who was present at, or after death, who determined the cause of death. Additionally, since calcula-

Table 3.1 Number of registered death certificates used to create database.

Year	Live-Born	Stillbirths	Total
1925	233	99	332
1926	191	110	301
1927	180	106	286
1928	176	115	291
1929	202	114	317
1930	178	129	309
1931	180	120	300
1932	182	111	293
1933	155	94	249
1934	144	104	248
1935	126	101	227
TOTAL	**1,947**	**1,203**	**3,150**

Source: Government of Ontario 1925-36

tion of age on the death certificate was often imprecise and inaccurate, age at death was calculated in days using the date of birth and death with special attention paid to those who lived between February and March of leap years (1928 and 1932).

The availability of a home address is considered the most important criterion for inclusion in this study. Emery and McQuillan (1993) state that death registrations in Ontario during the early twentieth century were incomplete as they "include deaths of non-residents and miss deaths of residents that occurred elsewhere" (54). To minimize the inclusion of non-residents in this study, each home address was examined. If the address was outside the city of Hamilton, or if it indicated that the infant's parents, and thus the infant, lived outside the city limits (rural Hamilton), then the death certificate was excluded. In addition, the informant (the person providing information to complete the death certificate) had to state their relationship to the deceased and provide their address. In most cases, the informant was a parent, thus if there was any uncertainty about the home address, the informant's address was used for verification purposes. In cases of illegitimate births (outside of wedlock) where the father's name was missing, or included but crossed out, and the informant was a grandparent (parent of the mother), the informant's address was considered to be the same as the infant's address. It was also assumed that both the mother and infant lived with the mother's parents. If, however, a different address was provided for the deceased infant than the grandparent, the address of the deceased was considered to be the permanent place of residence.

Infant deaths that occur in the post-neonatal period (between 28 and 365 days after birth) are considered to be caused by forces in the external environment (Knodel and Kintner 1977). As this study is concerned with infant mortality in relation to the conditions within the city of Hamilton, post-neonatal deaths outside of the city may reflect conditions of other localities and could potentially skew the results. Therefore, infants who died outside of Hamilton were not included in the study.

To verify the completeness of the transcribed records, the total number of infant deaths collected from the death registers are compared to the official reported and published number of deaths for Hamilton (Table 3.2) and shown graphically in Figure 3.1. The average difference in the number of reported deaths and the Hamilton deaths by year is 11.5, which translates to an average annual accuracy of 94.1%. The general difference between the number of reported and actual municipal deaths is attributed to the exclusion of non-resident deaths in Hamilton. The largest difference is observed in 1929 where the gap between the two sources is 33 deaths. The city experienced an economic boom between 1926 and 1929 (Cassidy 1935:17), which could account for a higher number of visitors and migrants to Hamilton during these years. It is uncertain, however, whether this is a likely explanation for the increased number of non-municipal deaths seen specifically in 1929. Overall, however, the relatively low difference in the number of reported deaths and the observed pattern consistent with official reports suggest high accuracy of the data used and it is thus considered reliable.

To determine the reliability of the death certificate data used in this study, a discussion of the nature and accuracy of vital registration must be undertaken. Not much

Table 3.2 Number of municipal infant deaths included in this study compared to the number of official reported annual deaths for Hamilton, 1925-35.

Year	Reported Deaths[1]	Death Records Collected[2]	Difference	% Accuracy
1925	241	233	8	96.68
1926	199	191	8	95.98
1927	187	180	7	96.26
1928	190	176	14	92.63
1929	235	202	33	85.96
1930	187	178	9	95.19
1931	196	180	16	91.84
1932	192	182	10	94.79
1933	163	155	8	95.09
1934	148	144	4	97.30
1935	135	126	9	93.33
		AVERAGE	**11.5**	**94.1**

[1] Source: Province of Ontario 1925-1935
[2] Source: Government of Ontario 1925-1936

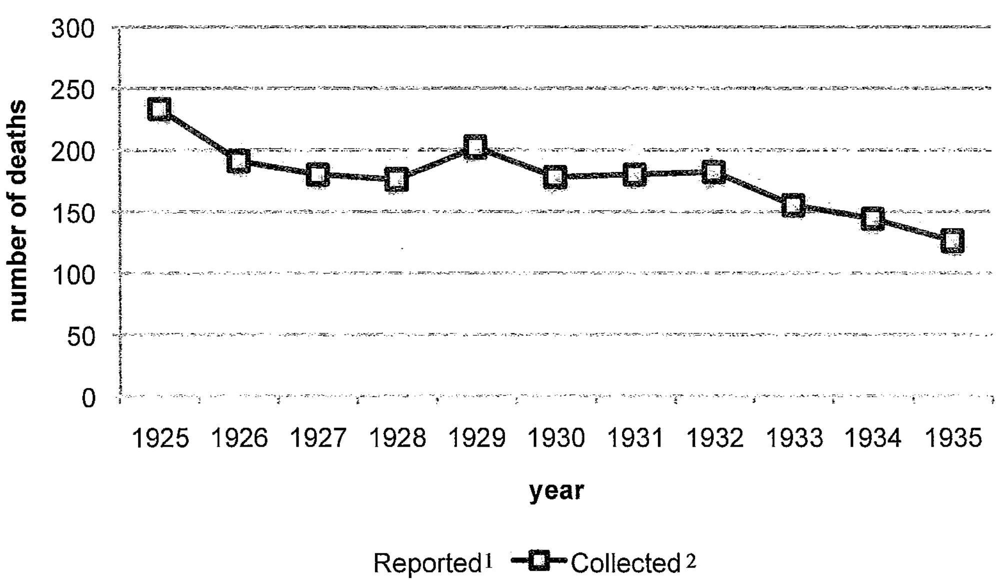


Figure 3.1 Number of Infant Deaths, City of Hamilton 1925-35.

[1] Source: Province of Ontario Sessional Papers 1925-1935
[2] Source: Government of Ontario 1925-1936

work has been conducted on the historical analysis of civil registration in the twentieth century, thus the discussion itself is limited to the work of one author, Emery (1993), who has conducted an in-depth study of vital registration for this time period focusing on Ontario, Canada. He states that prior to his analysis, the latest literature on Canada's civil registration system was published in the 1930's (7).

When working with death registry or any other civil registration system, one must keep in mind that the information contained reflects the social attitudes of the population living in that time period and must be used with caution (Emery 1993:3; Hoyert and Martin 2002). The questions asked by authorities and the way they are answered by citizens are based on what is considered significant to the goals of the individuals collecting the information and the ones providing it. These are socially constructed and therefore open to subjectivity. For example, contemporary death certificates in Canada no longer enquire about the "Racial Origin" of the deceased as the concept of *race* has changed radically over the past 100 years.

Canada adopted a civil registration system in the nineteenth century and modeled it after the one in use in England and Wales. In Ontario it was greatly influenced by public-health legislation as death rates were considered "indicators of environmental conditions and the 'quality' of the people" and were used to determine "where sanitary reform was needed" (Emery 1993:25). Death registries started to be increasingly complete after 1896 when it became illegal to obtain a permit for burial without a death certificate (Emery 1993:78). Due to a lack of legislation pertaining to civil registry, birth and death records were incomplete until the 1920's. The Vital Statistics Act of 1919 enforced penalties if births were not reported within 48 hours or cause of death within 24 hours of death (Emery 1993:40, 74). It is thus estimated that 96.4 percent and 97.3 percent of births for 1925 and 1935, respectively, were registered (Emery 1993:90). The interest in infant mortality and its implication for public health in the twentieth century gave doctors the incentive to record all deaths, and thus the registry of infant deaths and stillbirths in Ontario is considered complete by the 1930's (Emery 1993:104).

Stillbirths

Stillbirths are included in this study. There are two implications of this decision. First, although most specific causes of fetal death are unknown, they are understood to be caused by congenital factors (Cnattingius and Stephansson 2002). This, in combination with neonatal (age 0-27 days) mortality, which is also known to be caused by congenital factors (Knodel and Kintner 1977), can be used to assess the impact of maternal health on infant vitality. Second, standard definitions of stillbirths were not in place at the beginning of the twentieth century, internationally or within Canada. Even when definitions were finally agreed upon by the governing bodies and committees, "provincial and physician compliance with the...definitions varied" (Emery 1993:114-15). It wasn't until 1959 that Canada adopted the international definition of stillbirth, or "fetal death", put forth by the World Health Organization:

> [Fetal death is] death prior to the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy. The death is indicated by the fact that after such separation, the fetus does not breathe or show any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles. (Inter-Agency 1999)

In Canada, this definition applies to a fetus with minimum gestational age of 20 weeks or birth weight of 500g (Statistics Canada 2005).

Owing to the lack of consistency in the definition of stillbirths during the study period, an assessment of stillbirths was undertaken at the time of data collection. Regardless of the fact that an infant was classified as stillborn on the death certificate, if there was any indication that it was indeed live born (based on the current accepted Canadian definition) it was included in this study as a live birth. For example, in one case the cause of death was indicated as "stillbirth(?) – forceps delivery", but the age at death was recorded as "few minutes". In this particular case, since the stillbirth was questionable, especially because there were indications that the infant lived a few minutes, it was considered to be a live birth. Furthermore, many infants who were actually stillborn were not given a name on the death certificate; rather "Stillborn" was written in the section for "name". If, however, the "cause of death" section included a note that indicated a live birth, such as "took one breath" the entry was also included as live born. For deaths where no age was provided (in months, days, or hours), or if age was written as "0", with no direct indication of a stillbirth the infant was also included as a live birth. A total of ten entries with age at death indicated as "0" were found. They were classified as live births because several of those infants had indications in the "cause of death" section that they died *after* birth, such as; "foetus lived ½ hour" and "haemorrhage (sic) from cord which was not tied".

Cause of Death

Cause of death information is important because it constitutes a major part of the analysis of infant mortality. The Ontario death records list primary and secondary, or contributory, causes of death. In assessing cause of death, numerous studies indicate that even among modern practitioners the cause of mortality is not always correctly diagnosed (D'Amico et al., 1999; McAllum et al., 2005; Cohen et al., 2007; Lakkireddy et al., 2007), thus one cannot completely rely on the information on death certificates. This problem of inaccuracy can be attributed to a lack of knowledge of contributory causes (thus the child's medical history) or carelessness on the part of the practitioner (Scheper-Hughes, 1997).

Furthermore, the attribution of cause of death is influenced by factors such as "physician's concept of disease, the design of the death certificate, and the concealment of causes that the public stigmatize[s]." In the past "the published statistics were organized around the historical concept of an underlying cause" (Emery 1993:136). For example, when more than one cause of death was provided on the certificate, one was chosen over the others for the purpose of statistical classification. These choices were influenced by *International Lists,* which changed over time. One such change occurred in 1931, thus published statistics by cause of death were slightly different for the periods 1925-1930 and 1931-35.

The physician's concept of disease is the most influential factor in the pattern of cause-specific mortality. Historically, death has been attributed to ambiguous causes such as "convulsions", "debility", "haemorrhage" and "infantile debility" (Emery 1993:36);

these assessments of cause of death were observed in the death registries for Hamilton between 1925 and 1935. From a contemporary biomedical approach, some of these "causes", such as hemorrhage, are actually considered to be symptoms and do not reflect the underlying cause responsible for its manifestation; from a humoral school of thought, however, "haemorrhage" was considered a legitimate cause of death. Furthermore, an increased incidence of a disease as cause of death in mortality statistics may not necessarily reflect the true rise in cases but may simply indicate "enhancements in the diagnostic capacities of physicians" (Emery 1993:11). In light of this point, the discussion will now shift to Hamilton's doctors.

Hamilton's Doctors

There were 215 doctors who certified the deaths of infants and stillbirths in Hamilton from 1925 to 1935. This includes 20 entries where the physician's name is illegible, which may be inflating the total. Some physicians had a disproportionate impact on this study because 69 percent of the 215 doctors certified the deaths of 10 or fewer infant deaths over the eleven-year period (Figure 3.2). Moreover, 6 percent of those doctors (13 of the 215 identified) were responsible for completing almost half of all infant and stillbirth registered deaths in Hamilton between 1925 and 1935 (Figure 3.3). These include Dr.'s M.G. Brown, E.C. Bagshaw, J.C. Eager, D. McLeod, R. Oliver, O.A. Cannon, R.E. Gayatt, L.L. Playfair, S.H. O'Brien, J.A. Simpson, D.H. Stewart, D.G. McIlwraith and A.A. Caulay.

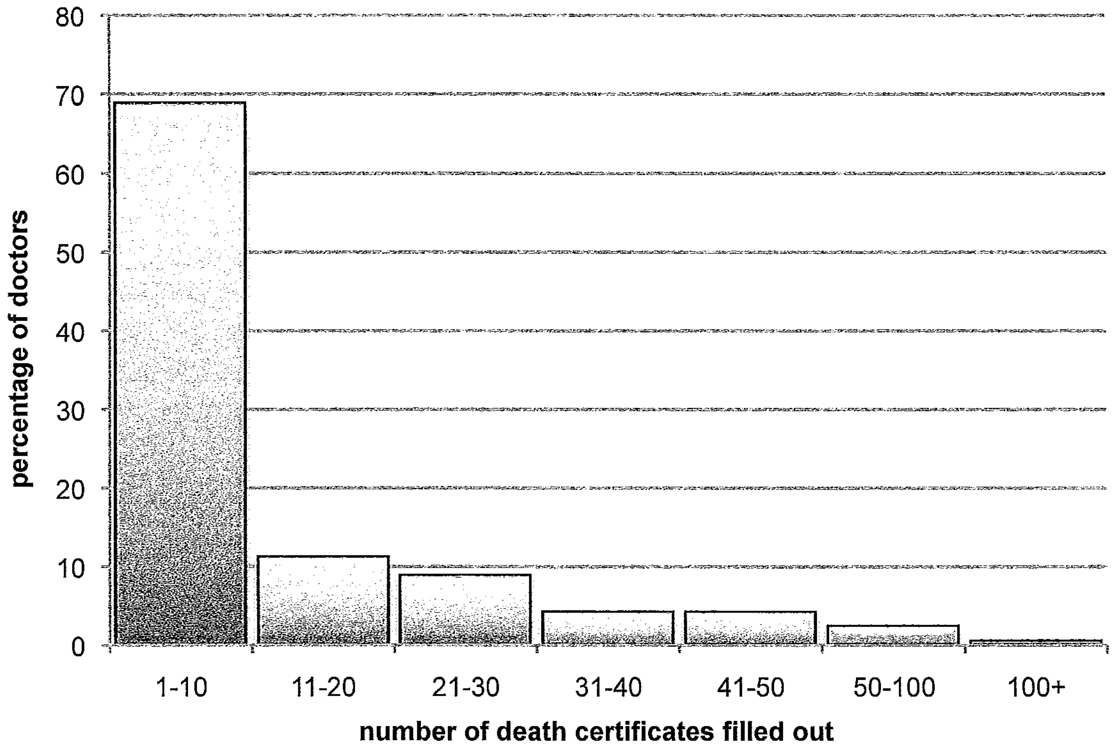


Figure 3.2 Proportion of physicians certifying cause of death for infants and stillbirths, City of Hamilton 1925-35.

Source: Government of Ontario 1925-1936

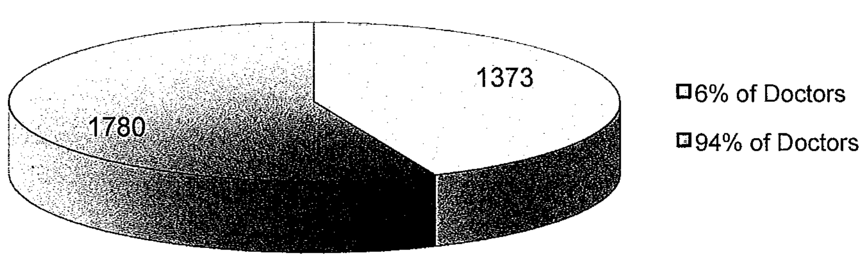


Figure 3.3 Proportion of death certificates filled out for infants and stillbirths, City of Hamilton, 1925-35.

Source: Government of Ontario 1925-1936

M.G. Brown graduated from Queen's University in 1916 and in 1919 became assistant medical superintendent of Hamilton General Hospital, the largest hospital in the city (Stott 1995:197). It is perhaps for this reason that he singlehandedly completed 725 death certificates included in this study.

Dr. Elizabeth C. Bagshaw graduated from Toronto Women's Medical College in 1905 and was a distinguished physician practicing family medicine in Hamilton, specializing in gynecology and obstetrics. She was a major figure in the Planned Parenthood Society of Hamilton, which opened in 1932 (Stott 1995:195). Due to her professional specialization, Dr. Bagshaw contributed the second to highest number of cause of death analyses in this study as she completed 73 death certificates.

Another obstetrician, Dr. J.C. Eager, is responsible for pronouncing cause of death in 69 cases. He obtained his medical degree from University of Toronto in 1912 and interned at Hamilton General Hospital. He began to practice medicine in Hamilton in 1919 after the First World War (Stott 1995:201).

The remaining doctors for whom biographical information was found were mostly general practitioners; few had specialized training in obstetrics, one was practicing general surgery, and two were coroners (one chief and one assistant). They all obtained their medical degrees between 1901 and 1924.

Analysis of the physicians responsible for identifying the cause of death is important as their medical specialization influences the level of accuracy and their professional qualification to make such assessments. For example, a doctor who specializes in obstetrics, or one who holds a position as a coroner, is well qualified to correctly identify mortality by cause due to the nature of their specialization. General practitioners today may not be occupationally exposed to infant death on a regular basis and therefore may be less qualified to make a correct assessment of cause of death. Since hospitalization was only starting to increase in popularity in the 1920's and 1930's among the middle class (Emery 1993:139; Smith 2004:23), general practitioners were more likely to be present at the death of an infant during the study period as it was common at that time to make house calls (Smith 2004:15) and thus they were likely well qualified to correctly identify cause of death.

In addition to their medical specialization, the prevailing philosophy of disease at the time of training plays a critical role in the way in which a physician evaluates cause of death. The discovery of pathogenic bacteria was made in the 1880's and since then the "*microbiological* or *specific-disease-entity* understanding gradually took hold…[and was] diffused unevenly among provincial physicians" (Emery 1993:11, emphasis in original). Thus if a doctor were trained within the humoral school before the paradigm shift to biomedicine was accepted, this would influence his or her ascriptions of cause of death.

The sheer number of different physicians certifying causes of death during this time introduces a problem in itself. Although all trained in medicine, there is still a fair amount of subjectivity involved in determining the cause of mortality. Israel et al. (1986) state that the "[s]ources of variation among certifiers may affect the reporting of medical conditions on the death certificate" (166). In fact, the primary source of errors in incorrectly identifying a cause of death has been found to be the physician or coroner (Glasser 1981:231). When using this type of material as a source in epidemiological studies, it is important to consider that the information it contains is dependent upon the individual's "medical opinion about what conditions may be related to a death" (Israel et al. 1986:166). In addition to personal interpretation of cause of mortality, an individual's handwriting can introduce further error. The "cause of death" section of the registered death certificates was filled out by hand and was often difficult to read. If, however, one individual had completed many death certificates, as in the case of Dr. Brown, their writing became more familiar and legible to the researcher, thus there was a higher chance of correctly reading and transcribing the information. Nineteen death certificates had to be excluded from this study due to illegibility of the cause of death.

In addition to the major limitations of using death registry data discussed above, other minor errors were noted during the transcription stage. In some cases the child's name did not correspond with the indicated sex of the deceased. For example, "Marian", an infant identified to be of Polish descent, was classified as "Female", yet in Polish culture "Marian" is a boy's name. Spelling errors, particularly in names, were also identified but were corrected during transcription. These errors may have occurred due to language barriers between the many immigrants settling in Hamilton and the locals who were filling in the death certificates. Misspelled names have no direct impact on this study. Inconsistencies in reporting name and sex of the deceased were noted in fewer than 10 records and therefore did not bias the analysis.

Assessment Rolls

The City of Hamilton Assessment Rolls, owned and stored by the City Clerk's

Office in Hamilton, Ontario, are a rich source of information and have been used in historical studies by Doucet and Weaver (1991) and Katz (1975). They contain, but are not limited to, information about the value of land, housing structures, number of people living in a household, and, for some years, the number of births and deaths, and the number of horses owned. Before a detailed discussion of the Assessment Rolls as a source of data is presented, it is important to review Hamilton's ward system and its social characteristics.

During the study period, the city of Hamilton was divided into 8 wards (see Figure 2.8). Although the city and ward boundaries changed in 1931, the overall social geography of Hamilton and the wards remained constant between 1925 and 1935. Using the Assessment Rolls, Doucet and Weaver (1991) conducted an in-depth analysis of the city's wards. Although in the mid-nineteenth century geographic class segregation was pronounced across Hamilton, a tendency for social mixing developed around the turn of the century. Due to the housing expansion and economic boom of the 1920's, spatial exclusivity returned as "deliberate efforts at discrimination by land developers" was introduced to increase the value of property in certain neighbourhoods (Doucet and Weaver 1991:450). For this reason, Hamilton's wards once again became socially distinct.

Wards 1, 2, 3 and the west part of ward 4 (Westdale) in the city's southern section were areas populated by citizens of higher economic and social status, identified through the over-representation of professionals and proprietors (the elite), and white-collar workers (upper middle-class). In contrast, blue-collar workers, or skilled and semi-skilled workers (middle-class), as well as common labourers (the poor) were underrepresented (Doucet and Weaver 1991:453). As only 33.9 percent of the total population of Hamilton lived in these wards, population density was low and houses were big, expensive, and built on sizeable lots. Bounded by the Niagara Escarpment to the south, this part of Hamilton was geographically at higher elevation than the northern part of the city.

Wards 7 and 8 were located in the northeast section of the city. In addition to the numerous factories built along the shoreline, this part of town was home to most blue-collar workers and to some common labourers who were employed by the neighbouring factories (Doucet and Weaver 1991:453). It is perhaps unnecessary to point out that the elite and upper middle-class were significantly underrepresented in these wards. As 41.5 percent of the city's population lived here, the houses were generally small and built close together on small plots of land. With the decrease in elevation toward the waterfront in the north, in addition to the increasing proximity to factories and their pollutants, the quality of housing and environment in these wards was noted to decrease (Doucet and Weaver 1991:455) (Figure 3.4).

Wards 5 and 6 and the eastern half of ward 4 shared the same topography as wards 7 and 8 and thus a similar trend in housing quality of environment was observed among them. These wards, however, were home to mostly common labourers and were categorized as having the poorest housing in the city. The other three occupational groups were thus, not surprisingly, largely absent from these areas (Doucet and Weaver 1991:453). It is in these wards that "[c]ommon labourers…remained relatively separate"

Figure 3.4 Smoke Emitted from the Steel Works, where Many Immigrants Worked and Lived Nearby. Hamilton, early 1900s.
Source: McMaster University, Labour Studies Collection.

from the rest of Hamilton's population where they "endured [typically] inferior environments" and poor housing conditions (Doucet and Weaver 1991:451-2) (Figure 3.5).

The Assessment Roll information was collected door-to-door by the assessment department mid-year of every year and was reported by ward (including annexes) (Hamilton Assessment Department 1926-1936). The information was organized into totals for each ward and was presented at the end of each volume in a "Recapitulation" section. The assessments for land and house value, as well as household size, was issued

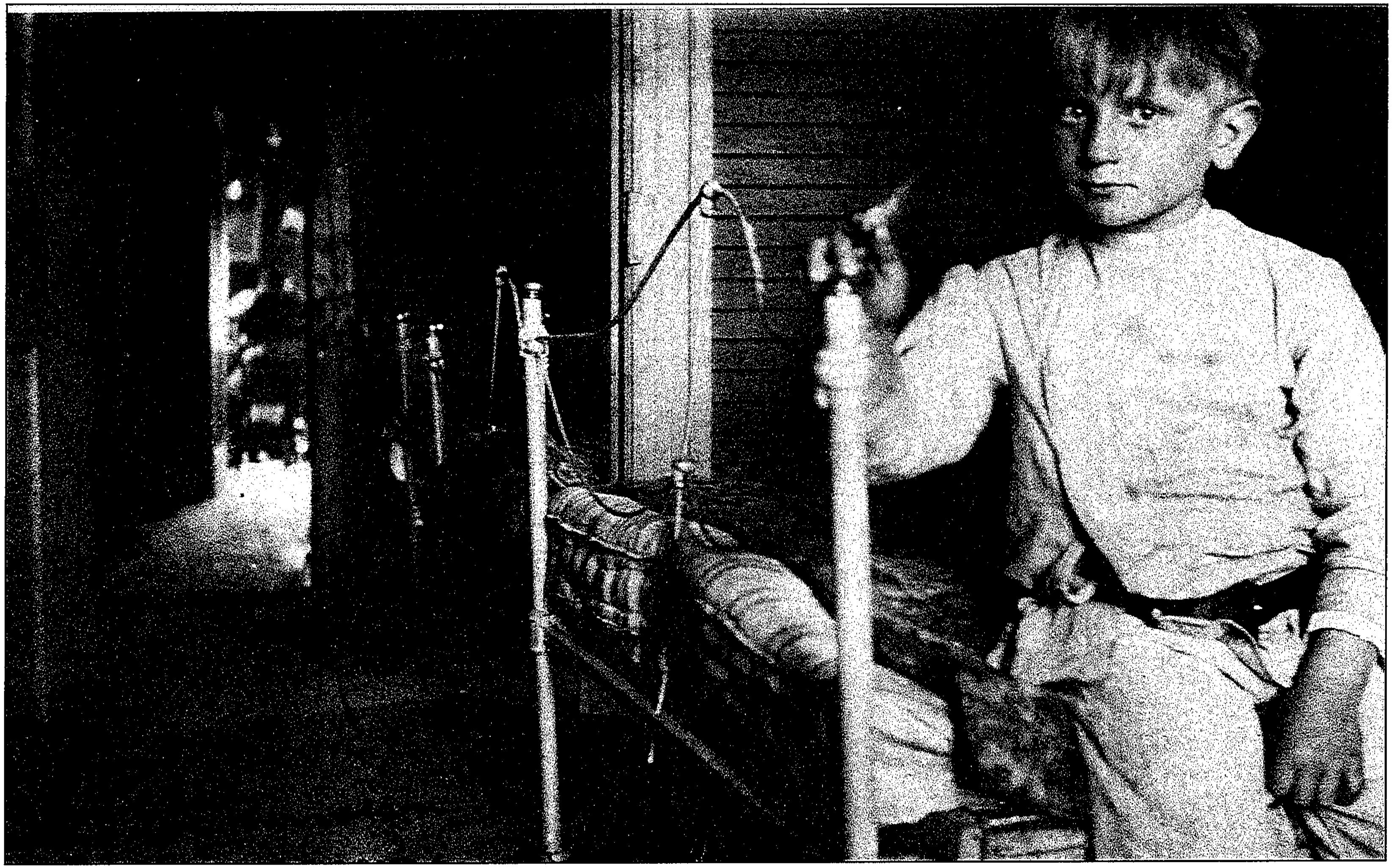


Figure 3.5 Russian Lodging House in the North End, Hamilton, pre-1930s.

Source: McMaster University, Labour Studies Collection

with a lag of one year (i.e. population for 1925 was reported in the 1926 volume); the birth and death information was issued with a two-year lag (i.e. deaths for 1925 were reported in the 1927 volume).

The information of interest to this study includes population size and number of births by ward for years 1925 to 1935 (Hamilton Assessment Department 1926-1936). These were collected from the "Recapitulation" section. Population totals were available for the entire study period (Table 3.3). The number of births, however, was only collected until 1930, as a change to the Assessment Rolls in 1933 no longer included these statistics (Table 3.4).

The collection of population data from the Assessment Rolls proved to be somewhat problematic. The population of each ward may be inaccurately reported if families had moved between the time of death indicated on the death record (i.e. at the beginning of the year) and the collection of information for the city assessment, which occurred in mid-year (Hamilton Assessment Department 1926-1936). This type of bias is considered to be insignificant given the large size of Hamilton's population.

A greater source of bias could be caused by what Doucet and Weaver (1991) identified as a time of rapid economic and housing expansion in Hamilton in the 1920's. New subdivisions were added to the city at an astounding rate. Although an official annexation of east, west, and part of the land south of the city atop the Niagara Escarpment occurred in 1931 officially changing the city and ward boundaries, subdivisions were unofficially considered to be part of Hamilton as they were built and included as parts of wards without clear distinction in the Assessment Rolls (Doucet and

Table 3.3 Ward Populations, City of Hamilton 1925-35.

Year	Ward[1] 1	2	3	4	5	6	7	8	Ward Totals[1]	Totals (incl. annexes)[1]	Reported Total[2]	Accuracy of Asses. Rolls (%)
1925	13,943	12,282	14,855	11,127	12,347	16,911	15,723	18,889	121,945	**121,945**	**123,328**	98.88
1926	15,021	12,294	14,779	11,313	12,211	16,874	15,562	19,118	123,359	**123,359**	**123,875**	99.58
1927	14,683	12,364	15,293	11,468	12,525	16,993	16,566	19,687	126,365	**126,365**	**127,447**	99.15
1928	15,574	12,938	15,438	11,671	12,342	17,459	16,855	19,912	129,711	**131,096**	**127,447**	98.25
1929	20,996	15,524	15,717	12,307	12,975	18,420	17,609	20,893	143,039	**143,039**	**134,566**	94.08
1930	22,272	16,001	16,406	13,214	13,263	18,761	18,271	21,429	148,676	**150,065**	**144,529**	97.21
1931	23,695	16,171	16,616	13,769	13,873	19,254	18,162	31,706	153,246	**154,701**	**155,547**	98.52
1932	20,776	16,152	18,278	14,199	18,747	23,359	20,833	21,160	153,504	**153,504**	**153,504**	100.00
1933	20,975	16,059	18,238	14,233	18,652	23,299	21,230	21,590	154,276	**154,276**	**154,276**	100.00
1934	21,194	16,072	18,218	14,318	18,674	23,094	20,823	23,094	155,487	**155,487**	**154,148**	99.14
1935	21,369	16,279	18,271	14,646	18,555	22,887	20,615	21,400	154,022	**154,022**	**154,020**	100.00

[1] Source: Hamilton Assessment Department 1926-1937
[2] Source: Province of Ontario Sessional Papers 1925-1935

Table 3.4 Number of Births by Ward, City of Hamilton 1925-30.

Year	Ward[1] 1	2	3	4	5	6	7	8	Ward Totals[1]	Total (incl. annexes)[1]	Reported Total[2]	Accuracy of Asses. Rolls (%)
1925	229	139	238	260	213	312	296	420	2,107	**2,265**	**2,938**	77.09
1926	218	158	237	230	173	245	276	427	1,964	**2,147**	**2,774**	77.40
1927	226	127	186	216	182	263	298	436	2,120	**2,159**	**2,866**	73.97
1928	326	211	255	159	206	288	306	392	2,143	**2,362**	**3,007**	78.55
1929	303	221	335	217	183	213	308	407	2,187	**2,423**	**3,166**	75.49
1930	358	191	353	203	229	314	217	445	2,310	**2,570**	**3,394**	74.93

[1] Source: Hamilton Assessment Department 1927-1932
[2] Source: Province of Ontario Sessional Papers 1925-1930

Weaver 1991:88). When this happened, some ward volumes may have included the information for annexations in their totals. Since this distinction between wards and annexations was not always made clear, a bias may be introduced either inflating or deflating the actual ward population data. The potential for bias was controlled where possible in this study. After 1930, however, the population totals become increasingly accurate and complete population data is provided for 1932 and 1933 (Figure 3.6).

Due to the unavailability of registered birth records for the city for this time period, and the need in this study to examine spatial distribution of births in Hamilton by ward, the Assessment Rolls proved to be a valuable source of information. The accuracy of the number of births obtained from the Assessment Rolls is compared to the official

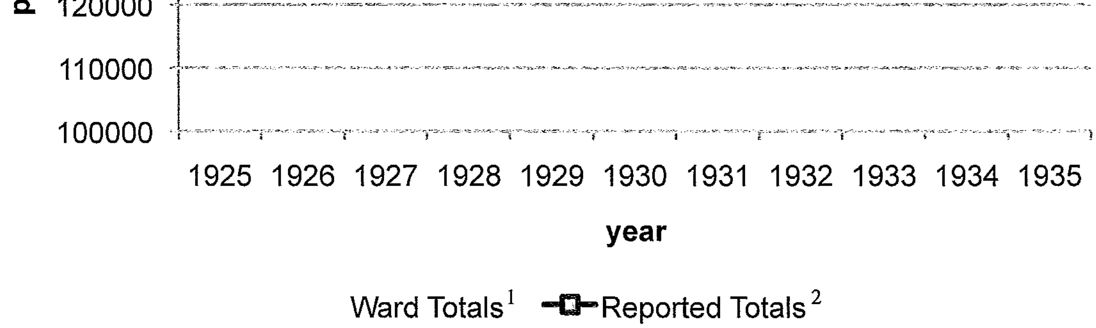


Figure 3.6 Annual Population, City of Hamilton 1925-35.

[1] Source: Hamilton Assessment Department 1926-1935
[2] Source: Province of Ontario Sessional Papers, 1925-1935

reported number of live births by year in Hamilton in Table 3.3. At best, an accuracy of 78.6 percent is obtained using the Assessment records if the total reported births for all wards *and* annexes is used. This is problematic because clearly, not all officially reported births for Hamilton were recorded. The number of births in Hamilton was consistently underreported by approximately 24 percent for each year (Figure 3.7).

The difference in the number of births in the official reports and the number of births collected from the Assessment Rolls, however, is explained by the inclusion of non-resident births as part of Hamilton's official statistics report. By the 1920's, Hamilton had three fully functioning medical hospitals equipped with the latest technology of its

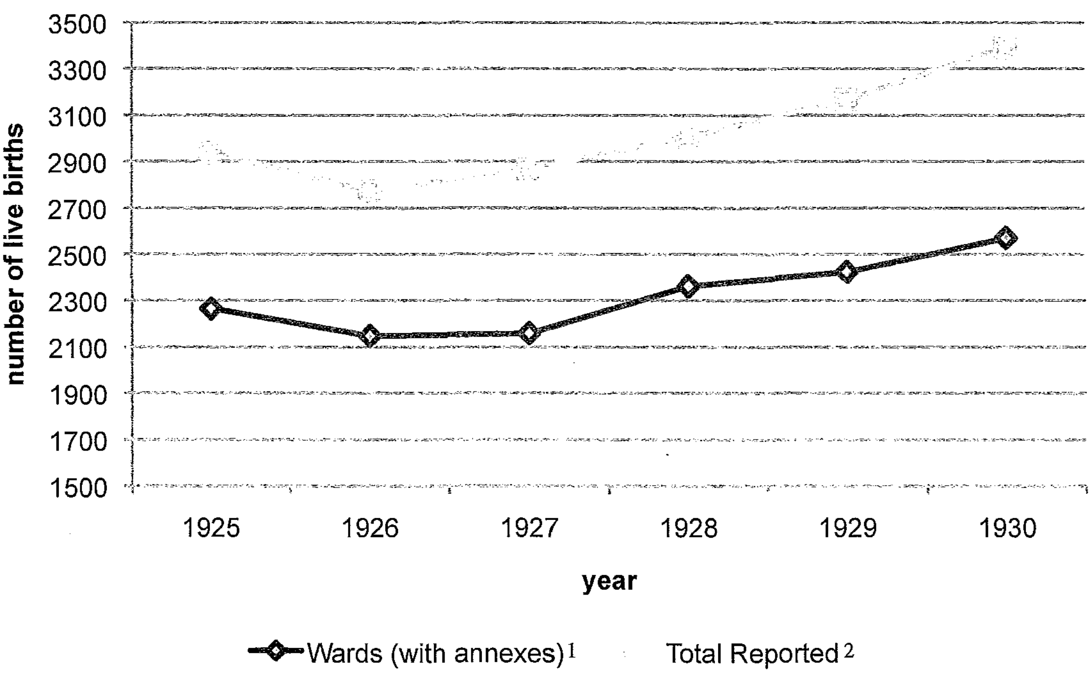


Figure 3.7 Annual Number of Births, City of Hamilton 1925-30.

[1] Source: Hamilton Assessment Department 1927-1932
[2] Source: Province of Ontario Sessional Papers, 1925-1930

times (Hill 1989). The 1920's marked a social and cultural shift from home births to an increasing number of institutional births (Emery 1993:139; Mitchinson 2002:173). Emery notes that "[m]edical hospital locations inflated the birth…totals for cities and towns" (1993:149), which is a likely explanation for the high number of official reported births in Hamilton. Another possible explanation lies in cultural differences. The city of Hamilton was home to tens of thousands of immigrants (Doucet and Weaver 1991; Katz 1975) and was thus highly culturally diverse. Emery (1993) has identified "a disproportionate underreporting of births for continental European ethnic groups" in the 1920 delayed birth registrations (94-5), however he does not explain this point and states that its use as evidence is limited. Nevertheless, this does suggest that unidentified social and cultural factors may exist that could potentially influence the reporting of births among culturally diverse populations.

The original data for the City of Hamilton Assessment Rolls was obtained through door-to-door survey method. Although data collected through personal reports is considered to be more reliable than official records (Scheper-Hughes 1997), it may also present its own inaccuracies. People may forget how many births or deaths occurred in the household, particularly due to the aforementioned two-year lag. Due to the nature of data collection, the information used in the Assessment Rolls may have been reported by children or other family members who may not have known the accurate information. Though unquestionably flawed, the data from the Assessment Rolls has proven to be absolutely indispensible to this study as no other sources have identified annual population and birth totals by ward.

Other Archival Sources

The qualitative data used to assess economic conditions in the City of Hamilton were collected from newspapers (The Hamilton Spectator; The Hamilton Herald), city of Hamilton board of health minutes (Hamilton Board of Health 1925-1935), Hamilton board of health annual reports (Hamilton Health Association 1925-1935) and secondary literature (Horn 1972, 1988). Since newspapers are the main source used for qualitative analysis in this study, a brief discussion of their use and limitations follows.

Newspapers are a rich source of data as they not only report local events, but also social attitudes of the time. They are entirely socially constructed; "[t]hey are economically and politically driven, [and are] linked to developments in science and technology" (Spitulnik 1993:293). Emery and McQuillan's (1993) case study, however, reveals that "mass media serve the interest of a ruling class" (Spitulnik 1993:295). Therefore it is expected that the stories covered must typically be newsworthy to the more affluent, and literate, population rather than the poor, and typically non-English speaking immigrant populations of places such as Hamilton. Although inaccuracies are expected because news stories are based on personal opinions and bias, it is these opinions that allow researchers to understand events at the local level.

Emery and McQuillan (1993) combined obituaries and death notices published in the local newspapers with death registry data to complete the mortality profile for Ingersoll (North Oxford and West Oxford townsips), Ontario. A similar approach could be taken to increase accuracy of the infant mortality profile for Hamilton, but this would have entailed analyzing the two major newspapers for the city of Hamilton over a period of eleven years, an undertaking beyond the scope of this project. As previously mentioned, the death registries were considered complete, or near complete, in Ontario in the 1920's, thus the addition of a small number of infant deaths would not significantly improve accuracy. Moreover, there is a bias in the publication of death notices and obituaries in newspapers because the decision of what to publish lies with the editor. Emery and McQuillan (1993) reported that the published deaths were ones "that the editor deemed to be of local interest and also deaths of persons whose relatives paid for a notice" (54-55). With careful evaluation of content, however, newspapers can be a powerful source of information in historical studies of society and culture.

Maps

The historical maps used in this study were large survey maps completed in 1927 and 1930 (Kirk 1927; McFaul 1930). They proved to be most useful for verifying addresses during the plotting and spatial analysis stages of GIS. These maps are very detailed and include plot division and plot sizes, locations of permanent industrial and commercial structures as well as their names (i.e. Stelco), and the ward and city boundaries. These did not, however, illustrate the size, location or street numbers of private dwellings, which made it difficult to discern the plots that had erected housing structures and those that were still being developed.

Methods

Study Period

In order to assess the impact of economic recession on infant mortality, the study period is divided into two death cohorts based on year of death; pre-depression (1925-1929) and depression (1930-1935). Although the Great Depression started in October 1929, data from 1929 are included in the pre-depression period for two reasons: 1) the first nine months of the year are pre-depression thus most of the deaths in 1929 occurred before the Great Depression started; and 2) an economic recession would not have affected the socioeconomic conditions drastically over a 3 month period, especially in Hamilton, because Ontario was somewhat buffered against the burdens of the Depression (Horn, 1972).

Age Categories

A distinction between stillbirths, neonatal (age 0-27 days) and post-neonatal (age 28-365 days) deaths is made and the three age categories are analyzed separately. Mortality in the first year of life is partitioned based on components that reflect changes in the infant's environment. Neonatal mortality is usually attributed to intrinsic factors, such as congenital defects and complications caused by the birth process. The neonatal mortality rate is used as an indicator of maternal health, the quality of prenatal and obstetric care, as well as medical care available to the newborn (Richardus et al. 1998:55; World Health Organization 2006). Increased infant mortality during the neonatal period has been associated with lower socioeconomic status, education levels, as well as poorer quality of, or lack of access to, perinatal care (Borrell et al. 2003:5).

Post-neonatal mortality is caused by extrinsic factors associated with the environment, including sanitation, nutrition, exposure to disease and other factors attributed to socio-economic conditions (Knodel and Kintner 1977; Galley and Woods 1999). The post-neonatal mortality rate is indicative specifically of the living standards, housing and sanitary conditions and the overall social, and to some extent cultural, environment.

Although stillbirths are not typically included in demographic research using infant mortality rates, they are known to be caused by maternal factors (Cnattingius and Stephansson 2002). Stillbirths are not included in the spatial analysis in this study but are used in conjunction with the annual assessment of neonatal mortality as an indicator of the quality of maternal health (World Health Organization 2005) as well as the quality of perinatal and obstetric care in Hamilton (Richardus et al. 1998:55; World Health Organization 2006).

Infant Mortality Rates

The infant mortality rate (IMR) is widely used in demographic and social studies "as an indicator of poor living conditions" (Mercier and Boone 2002:486). The standard calculation for infant mortality is (Statistics Canada 1993):

$$\text{IMR} = \frac{\text{number of infant deaths}}{\text{number of live births}} \times 1000$$

Contemporary reports placed the infant mortality rate for high income countries at an average of 6 deaths per 1,000 live births in 2006. In contrast, low income countries fared considerably worse, at an average of 73 infant deaths per 1,000 live births, while upper- and lower-middle income countries had an average IMR of 22 and 27, respectively (WHO 2008). In this study, the estimated IMRs for Hamilton are referred to based on these statistics. A "high" IMR is one that falls above the current highest reported average for low income countries (> 73). "Moderate" refers to an IMR between 22 and 73, and a "low" IMR is less than 22 infant deaths per 1,000 live births.

The IMR for Hamilton is estimated and analyzed for each year by ward, and for the city, during the pre-depression and depression periods. These are compared to the national and provincial rates obtained from other sources (Statistics Canada 1993). Only those deaths plotted using GIS are used as the numerator to calculate the IMR as they most accurately reflect the true municipal deaths as well as ward IMRs. It must be mentioned, however, that this results in an underestimate of the official reported IMR for Hamilton overall. To calculate the municipal IMR, the number of live births was obtained from both the Reports of the Registrar General and the City Assessment Rolls, resulting in two sets of estimates for Hamilton.

Due to lack of information on births by ward after 1930, the number of live births had to be estimated for 1931-35. Births for each ward during the depression period are estimated by applying the pre-depression (including 1930) proportion to the officially reported births in the same wards for the depression years. For example, of a total 13,827 births reported in the Assessment Rolls for 1925-30 (Hamilton Assessment Department

1927-1932), 1,660, or 12.0 percent of those births were reported by families living in ward 1. Therefore, of the total 14,788 officially reported births between 1931 and 1935 (Province of Ontario 1931-1935), 12.0 percent, or 1,775 births are estimated to have occurred in ward 1.

Considering that these estimates are based on the total reported births in Hamilton, including non-municipal births (Province of Ontario 1931-1935), this actually results in an *overestimate* of the true number of municipal births. To overcome this, an additional

Table 3.5 Number of Births by Ward, City of Hamilton 1925-35.

		Ward								
	Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Asses. Roll[1] Births	1925	229	139	238	260	213	312	296	578	**2,265**
	1926	218	158	237	230	173	245	276	610	**2,147**
	1927	226	127	186	216	182	263	298	622	**2,120**
	1928	326	211	255	159	206	288	306	611	**2,362**
	1929	303	221	335	217	183	213	308	610	**2,390**
	1930	358	191	353	203	229	314	217	678	**2,543**
Reported[2] Birth Estimates	1931	399	251	385	309	285	393	408	891	**3,320**
	1932	373	236	361	289	267	368	383	835	**3,111**
	1933	344	217	332	266	246	339	352	768	**2,864**
	1934	328	207	317	254	234	323	336	732	**2,730**
	1935	332	209	321	257	237	327	340	741	**2,763**
Asses. Roll[3] Birth Estimates	1931	312	197	302	242	223	307	320	697	**2,600**
	1932	287	181	277	222	205	283	294	641	**2,391**
	1933	257	162	249	199	184	254	264	575	**2,144**
	1934	241	152	233	187	172	238	247	539	**2,010**
	1935	245	155	237	190	175	242	251	548	**2,043**

[1] Source: Hamilton Assessment Department 1927-1932
[2] Source: Annual totals obtained from Province of Ontario Sessional Papers 1925-1935
[3] Annual number of births is estimated by subtracting the average difference between the official reported births and the assessment roll births (average = 712) for 1925-30 from the annual official reported births for 1931-35.

estimate of total annual births in Hamilton reflecting the Assessment Roll totals is used. The annual number of births is calculated by subtracting the average annual difference between the official reported births and the assessment roll births (average = 712) for 1925-30 from the annual official reported births for 1931-35. The individual ward birth totals by year for 1931-35 are calculated using the ward birth proportions as described above. The estimates for both analyses are displayed in Table 3.5.

GIS and Population Density

GIS

Geographic Information System, or GIS, is "[a]n integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes" (Wade and Sommer 2006:90). GIS is powerful and unique in that the user can input data into the program to be spatially displayed and analyzed. It allows for the analysis of not only geographic locations, but also the information a researcher may link to those locations (Breslin et al. 1999:1-6). GIS is a useful tool for numerous types of research across various disciplines. In this study, ArcView GIS version 3.2 is used primarily for plotting infant deaths to conduct spatial analysis of mortality across Hamilton. It is also used to calculate city area and to analyze the ecological and environmental conditions across the city through the spatial distribution of water mains and sewer lines. The file containing information for sewer and water mains was obtained from the City of Hamilton and includes installation dates for each section since the commencement of its construction in the nineteenth century.

The use of GIS presents a unique problem because a file containing contemporary geographic information, including street names, city boundaries and shorelines must be used in this historical study since digital archival maps have not been constructed for use in GIS. Large-scale construction and urban renewal has taken place altering residential and industrial areas as well as the shoreline of Hamilton. A recent historical reconstruction of the early twentieth-century Hamilton harbour has been completed and was obtained from the City of Hamilton as a digital file to include in this study (City of Hamilton 2008a). The availability of this data allows for a more accurate measurement of ward and city area.

The locations of the infant deaths in Hamilton were plotted using the geocoding function in GIS which allows the program to calculate the geographic location of addresses and displays them as points (Breslin et al. 1999:5-13). The address information was gathered from the death certificates and inputted into a spreadsheet. As postal codes were not introduced in Canada until 1971 (Canadian Museum of Civilizations 2001), the option for geocoding using postal codes was not available. Instead, the house number, street name, street type (such as 'drive', 'boulevard' etc.) and direction (north, south etc.) were used to pinpoint locations in GIS.

The majority of street names in Hamilton have remained the same since 1935 but some differences, including a change in house numbers, have been noted due to urban development. To minimize error, addresses were automatically plotted in GIS only if all of the above categories of input data matched. If any one of the categories did not match, each incomplete address was analyzed individually to correct the data where possible.

The most common problem was a lack of direction in the street address. To rectify any problems where a match could not be found, the Hamilton City Registry was consulted to obtain a complete address. If, however, the family address was not verified in the City Registry, the data for that death was excluded from the study. A total of 1,792 of the 1,947 collected infant deaths for Hamilton (92.0 percent) were plotted successfully (Table 3.6). To ensure maximum accuracy, a historical map of Hamilton (Kirk 1927) was consulted during the plotting process.

Table 3.6 Number of Infant Deaths Plotted Using GIS, City of Hamilton 1925-35.

Year	Plotted Deaths	Collected Deaths[1]	Percent Plotted
1925	203	233	87.12
1926	186	191	97.38
1927	163	180	90.56
1928	159	176	90.34
1929	187	202	92.57
1930	157	178	88.20
1931	152	180	84.44
1932	175	182	96.15
1933	146	155	94.19
1934	141	144	97.92
1935	123	126	97.62
Total	**1,792**	**1,947**	**92.04**

[1] Source: Government of Ontario 1925-1936

Population Density

Overcrowding predisposes people to increased interpersonal contact and thus an increase in transmission rates of certain infectious pathogens (Morse 1995:11). Therefore an analysis of population density is included in this study to determine what kind of an effect, if any, crowding may have had on health in Hamilton during the Great Depression. The data used to calculate population density by city ward relies on ward populations reported in the City of Hamilton Assessment Rolls (Hamilton Assessment Department, 1926-1936), and the ward areas obtained using GIS. Population density is expressed as the number of people per square kilometer (Table 3.7).

The calculation of ward area using GIS proved to be somewhat problematic; it was particularly difficult along the shoreline of Lake Ontario, which is shaped irregularly. The standard area measurement function on GIS can only be utilized on shape files. Since

Table 3.7 Population Density (people per km^2) by Ward, City of Hamilton 1925-35.

	Ward							
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1925	4,209	4,695	4,978	3,427	7,332	7,476	6,884	5,761
1926	4,534	4,700	4,953	3,484	7,251	7,460	6,813	5,889
1927	4,432	4,726	5,125	3,532	7,438	7,512	7,253	6,161
1928	4,701	4,946	5,174	3,594	7,329	7,718	7,380	6,384
1929	6,337	5,934	5,267	3,790	7,705	8,143	7,710	6,863
1930	6,723	6,117	5,498	4,070	7,876	8,294	8,000	7,095
1931	4,447	3,405	3,704	3,645	5,477	7,601	7,365	10,485
1932	3,899	3,401	4,074	3,759	7,401	9,222	8,448	6,997
1933	3,937	3,382	4,066	3,768	7,364	9,198	8,609	7,140
1934	3,978	3,384	4,061	3,791	7,372	9,117	8,444	7,637
1935	4,011	3,428	4,073	3,878	7,325	9,036	8,360	7,077

Source: Hamilton Assessment Department 1926-1936 the divisions of wards in Hamilton are arbitrary in relation to the file containing the map of Canada, the shape files of the wards were created by hand. Archival maps (McFaul 1930) were consulted to ensure that only developed non-industrial parts of wards were included in the calculation, as inclusion of this land would underestimate true density of living areas. GIS is a highly accurate and specialized geospatial software; the area computations were collected using a "measurement" function at a high magnification, and thus the error introduced through estimation is considered to be marginal and is not expected to affect the overall estimation of ward area and thus population density.

The analysis of the relationship between population density and infant mortality in this study is modeled after Woods (1984), who finds an association between infant mortality and high-density urban and low-density rural areas in Victorian England and Wales. This relationship is analyzed by plotting infant mortality against log population density. In his findings, Woods concludes that at high, or urban, population densities, infant mortality is predictably high, while at lower densities, typical of rural areas, there is much more variability in the infant mortality rate, therefore making infant mortality much less predictable at low densities.

Socioeconomic Status

Socio-economic status in historical demographic research is often defined in terms of the occupational class to which the head of the household belonged (Watterson 1988; Woods et al. 1988; Williams 1992; Doucet and Weaver 1991). Despite being "notoriously ambiguous" (Emery 1993:94), however, occupation remains the key indicator of socioeconomic status (SES) in historical studies (Haines 1979; Doucet and Weaver 1991; Thornton and Olson 1991) as it reflects access to resources through income and class position. Based on these categories, significant differences in infant mortality have been observed (Watterson 1988; Woods et al. 1988; Williams 1992). Since parental occupational information was not provided on the Hamilton death certificates, occupation cannot be used to determine SES in this study. Although it might be possible to trace the occupations using the municipal assessment rolls and the city registry, time constraints made this impossible. Instead, overall ward characteristics described by Doucet and Weaver (1991), which were analyzed by social geography, are used as general guides of SES across Hamilton.

Doucet and Weaver (1991) estimated a total of 172 blocks where "roughly 40 per cent of the houses had assessed values" below the average in 1936, indicating low income and poor living conditions (459-460). In this study, SES was ascribed to the plotted deaths according to the ward in which they were located (i.e. wards 1 and 2, 3 and western section of 4 – high SES; eastern part of ward 4, wards 5 and 6, and specified blocks – low SES; wards 7 and 8 – middle class) (based on Doucet and Weaver 1991). Unfortunately because the birth data are drawn from the assessment rolls, they cannot be divided into the 172 blocks used to partition the deaths and must follow the original ward divisions. Births for ward 4, for example, cannot be ascribed to the wealthy half and poorer half, but must be pooled into the single ward.

Based on the locations of the poorest blocks and other secondary sources (Doucet and Weaver 1991), the wards were pooled into two groups reflecting the overall SES:

higher SES in the south (wards 1-4) and lower SES in the north (wards 5-8). It must be noted, however, that SES is not homogeneous throughout the wards and some of the poorest areas were, in fact, located in the wealthier blocks (see Figure 3.8). Therefore the results offered in relation to ward differences in this study must be treated with caution.

Historical studies clearly indicate the association of illegitimacy with an increased risk of mortality compared to legitimate births (Woods et al. 1998; Brandstrom 1997; Kok et al. 1997; Macassa et al. 2005). Blakely et al. (2003) describe birth legitimacy as a good measure of SES because typically single parent households have lower income, especially when these households were headed by women who were substantially underpaid for

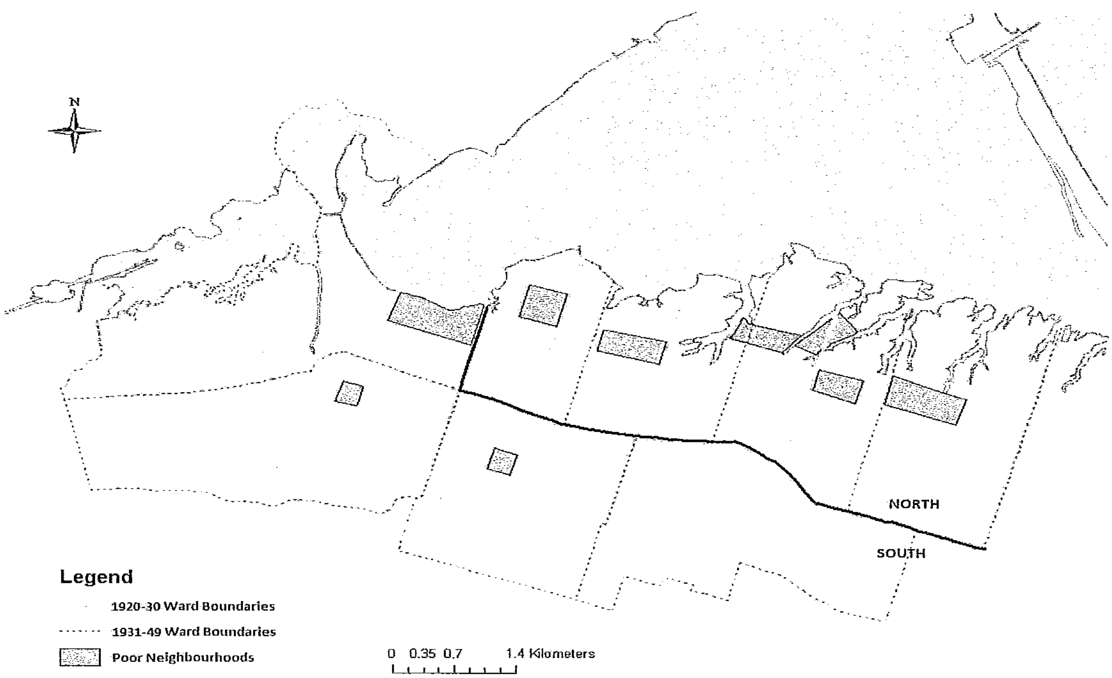


Figure 3.8 Poorest Neighbourhoods, City of Hamilton 1925-35.
Source: Doucet and Weaver 1991

their work in the early twentieth century (Doucet and Weaver 1991). Lower income thus decreases the potential for access to resources and results in lower SES and poorer health. In the registered death certificates for Hamilton, illegitimate births are either explicitly identified as such (in place of the father's name is written "illegitimate"), or can be inferred if the father's name is marked as "unknown" or is provided but crossed out; therefore, it is possible to use illegitimacy as an indicator of SES. The deaths of infants with illegitimate births (n = 122) are compared to the legitimate births (n = 1,666) to determine whether statistically significant differences in infant health and mortality patterns exist among these groups. Foundlings (infants whose neither parents are known) are excluded from this analysis (n = 4).

According to Leavitt's (1996) research of urban health in nineteenth and twentieth century Milwaukee, immigrants had the lowest chances of survival and were predisposed to the worst housing conditions in the poorest parts of the city (30-31). In this study, infant death records that list mother's country of birth (n = 1,771) were partitioned into deaths of infants born to Canadian (high SES) (n = 820) and foreign-born (low SES) (n = 951) mothers are compared to assess differences in infant health and mortality, and to aid in the identification of the SES of neighbourhoods across Hamilton. Foundlings were also excluded from this analysis.

Weaning and Breastfeeding

The biometric analysis of infant deaths was developed by Bourgeois-Pichat (1951, 1952) to determine the level of endogenous and exogenous causes of infant deaths within the first month of life. In developed countries today the use of this method is no longer necessary because very few infant deaths are observed from endogenous causes particularly due to biomedical procedures aimed at dealing with perinatal and congenital health problems (Lancaster 1990:299). Although this method is still useful in historical studies, it was devised to account for data where cause of death information is either unreliable or missing altogether. Since it was determined that the death registrations used in this study were both reliable and complete, it is not necessary to apply this method here for the purpose of determining endogenous and exogenous causes of neonatal death.

A secondary use of this method, however, has been proposed by Knodel and Kintner (1977) to examine the patterns of weaning and breastfeeding. Breastfeeding has long been established as a factor affecting infant mortality; the process of weaning and the introduction of transitional foods is associated with a higher risk of mortality due to poor nutrition and subsequent decrease in immunological function, as well as an increase of exposure to pathogens in unsanitary conditions (Knodel and Kintner 1977; Hendricks and Badruddin 1992; Fomon 2001).

The biometric analysis in this study follows the model outlined by Knodel and Kintner (1977) which is expressed by plotting the accumulated infant mortality against age since birth in days, n, where n is a function $[\log (n + 1)]^3$. A comparison of the cumulative mortality within the first six months (age at death = 0 to 6 months) is made with that of the second six month period (age at death = 6 to 12 months). If the slope in the early months of life rises more sharply than the second six-month segment, that is, if the ratio of the slopes is less than unity, this indicates that breastfeeding was stopped shortly after birth and that "excessive" mortality is observed (393). If, however, the opposite is true, then this indicates a longer period of breastfeeding and the introduction of complementary feeding at a later stage of infancy.

Cause of Death

The inclusion of the cause of death in the registered death certificates allows for in-depth cause-specific analysis. For the purpose of this research the cause of death data were first coded according to the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) (WHO 2007) and then divided into three general categories following McKeown's (1976) scheme: infectious, non-infectious, and unknown or non-specified. For infectious diseases, the categories are based on the route of contagion and include airborne (respiratory), water or food-borne (gastro-intestinal) diseases, and other (bacterial and viral infections where the route of transmission is either non-specific or unknown). Non-infectious diseases are divided into causes of death due to congenital factors and all other causes.

It must be noted, however, that reliance on the stated causes of mortality are problematic. Williams et al. (1994) state that this information is not always reliable; the cause of death may not be definitive even if stated by qualified practitioners in developed countries today unless an autopsy has been performed (175). Additionally, "the complexity of the disease process is difficult to summarize in simple statistical or tabular form [and thus a] cause-of-death classification is reductionist by necessity" (Ewbanks et al. 1993:17). For example, when a child is suffering from many conditions or diseases simultaneously and dies, the cause of death could be attributed to any one of the conditions observed. "Which of these conditions is regarded as the major cause…of death will depend on the judgment, interest, and training of the health care worker" (Williams et al. 1994:175). Therefore, when more than one cause of death is presented on the death certificates from the study period, it becomes difficult to determine which of those conditions directly resulted in death.

A second limitation of using cause-of-death data from this time period, as noted by McKeown (1976), was the arbitrary and vague diagnosis of cause of mortality (50). For example, the most frequent vague diagnoses assigned to cause of death in Hamilton during the study period were "inanition", "asthenia", "haemorrhage", "status thymico lymphaticus" and other thymus-related deaths, and "convulsions". Although McKeown assigns "convulsions" to respiratory infections, this study follows ICD-10 and Moffat (1992), listing "convulsions" as a non-specific cause of death.

Every attempt was made to establish a cause of death as accurately as possible utilizing both the primary and contributory cause of death. Nineteen entries were excluded due to illegibility. Considering the aforementioned limitations of using cause of death information, the primary cause of death was used to classify the disease process responsible for mortality in 92.7 percent of cases (1,644 of 1,773), with some exceptions. These exceptions (7.3 percent) included non-specific primary causes of death and multiple primary causes of death.

All of the deaths where the primary cause was non-specific and, if included, the contributory cause of death more clearly described the disease process, the classification of the death was based on the secondary / contributory cause. Additionally, if the primary cause of death were more indicative of an underlying cause rather than one directly responsible for mortality, such as in the case of "prematurity" (primary COD) and "broncho pneumonia" (secondary COD), then the secondary cause of death was used as a basis for classification. In this example, the infant most likely did not die of prematurity because it developed broncho pneumonia; rather it died of broncho pneumonia because it was too weak to fight off the infection due to prematurity.

When more than one primary cause of death was listed and would result in two different classifications of cause of death (following McKeown, such as "malnutrition and fermentative diarrhoea (sic)"), both were used resulting in two entries for one death. A specific problem was presented in the case of mortality due to diarrheal diseases and respiratory infections, also known as the "diarrheal complex" (Sawchuk et al. 1985). These two conditions were frequently presented together; sometimes the diarrheal diseases were listed as the primary cause, sometimes it was the respiratory infections, and at other times they were both listed as the primary cause of death. In light of Williams et al.'s (1994) statement about the subjectivity of assigning the major cause of death, to avoid inconsistencies, whenever diarrheal and respiratory infections appeared together as a cause of death, both were treated and classified as the primary cause resulting in two entries for one death certificate. Overall, 52 deaths had two listed primary causes, 38 of which were specifically the diarrheal/respiratory co-infection; one death had three listed primary causes (Table 3.8).

Table 3.8 Number of Certified Causes of Infant Death, City of Hamilton 1925-35.

	Single Cause	**Two Causes**	**Three Causes**	**Excluded (illegible)**	**Total**
Number of deaths	1,720	52[1]	1	19	**1,792**
				Total COD's	**1,827**

[1] 38 due to diarrhea/respiratory co-infection

Seasonality

The analysis of seasonal variation in mortality can illustrate two things about a community. First, it can be used to determine the most likely time of year a death will occur. Secondly, particularly in the case of infant mortality and infectious disease, it can help to determine the most likely disease agents responsible for the deaths (Moffat 1992:87). This type of analysis can also indicate times of stress on the overall health of the community when excess infant mortality is observed.

Knodel (2002) argues that simply looking at the seasonal fluctuations in infant mortality can be misleading, as this type of analysis does not account for the effects of seasonal and monthly fluctuations in the number of births (60). To overcome this, Knodel (2002) developed a method that measures the risk of infant mortality by month independent of the distorting effects of fluctuations in birth. This method uses both the monthly births and deaths to calculate the monthly infant mortality rate. For example, using the pre-depression birth and infant death data, there are 1,158 births recorded in January between 1925 and 1929. Of all the infants born in January over the five-year period, the 82 who died before reaching the age of one are categorized by the month in which they died (which is based on the date of death in the death certificate). Since 11 deaths occurred in February between 1925 and 1929, the probability of a baby born in January dying in February is 11 out of 1,158. These calculations are performed separately to obtain the "mortality risk by month of [death] for infants grouped according to month of birth" for each calendar month and are combined to produce the total IMRs for each month (Knodel 2002:61).

In addition to presenting the seasonal IMRs, an index value is estimated for the study period. Knodel (2002) designed this method to illustrate the monthly mortality in relation to the unweighted average IMR for the calendar year. Thus the index value of 130, for example, indicates that the risk of dying in that month is 30 percent higher than average. Therefore any value greater than 100 indicates an above-average mortality risk, while a value less than 100 shows a below-average mortality risk (Knodel 2002:62).

As no seasonal birth information by ward was collected by the assessment department, the births included in this part of analysis are from the official reports of the registrar general (Province of Ontario 1925-1935), thus allowing for an analysis of the entire study period. Although a more complete mortality profile would result if all 3,153 deaths were used, ward comparisons would not be possible, therefore only plotted infant deaths for whom there are addresses are included in the cause-specific analysis of mortality in Hamilton.

Statistical Analysis

The majority of data collected for this study are quantitative in nature allowing for statistical analyses. The analyses of the relationships between the aforementioned variables and infant mortality differ based on the nature of data and factors analyzed. The tests chosen to analyze data in this study are non-parametric. Chi-Square and Odds Ratio tests are preferred as the data are categorical and in many instances the samples are small once the deaths are partitioned into age, ward, month, and other categories of analysis. Furthermore, these tests are used to calculate the "frequency of occurrences or events" where one variable has several possible outcomes, which are observed in individuals (Madrigal 1998:192). It is the frequencies of these observations, or in other words the number of individuals with a certain outcome (in this study, death) that are compared. These tests were conducted using Epi Info™ version 3.4.3 statistical software. The software generates the Chi-Square statistic, the Odds Ratio (along with confidence limits), and the p value.

Since IMRs are the most accurate and accepted form of analyzing infant health, a simple statistical comparison of the proportions of infant deaths for each variable would not have met the analytical standards of this study. The nature of the calculations was limited to the comparison of infant mortality rates, thus no published protocol was followed. The two possible outcomes of the "infant" variable in this study was either death or survival. The infant deaths were therefore categorized as "died"; the "survived" category was the difference between all live births and the infant deaths. The sum of the two categories therefore adds up to the total number of births for the variable compared (such as year, ward etc.).

In addition to using Epi Info™, Microsoft Excel was used to calculate the average IMRs and confidence limits[2] in Table 4.2, which required two steps. First, the standard deviation[3] was calculated. Once this information was computed, the confidence limits for the data were obtained. Both functions for confidence limits and standard deviation are included with the software.

Conclusion

The major biases of using death certificates are the potential loss of municipal births and deaths of infants that occurred outside of Hamilton because of the nature of the civil registration system for the study period. Additionally, the poorest individuals who were at highest risk for mortality and morbidity are also not represented because they were likely missed at the municipal level (absent from Assessment Rolls if did not have a permanent address) and were not available for study. Although the death certificates used to collect the dataset for this study are complete and represent almost all officially reported deaths, several limitations of the data were observed. The lack of clear definitions of stillbirths during the study period may have resulted in the unintentional misclassification of stillbirth by the physicians. Furthermore, the large number of doctors certifying deaths at this time increased the amount of subjectivity in assigning the cause

[2] Function for confidence limits requires: significance (alpha) level, standard deviation of the population, and sample/population size.
[3] The standard deviation is automatically generated directly from the data set; no additional information is required to complete the calculation.

of death. Though likely well qualified, the ambiguity of some listed causes of mortality reflect the different understanding of disease, which makes it challenging to reliably determine the cause of infant deaths (based on contemporary medical philosophy).

The Assessment Roll information proved to be crucial to this study as it allows for ward-level analysis of the health conditions across Hamilton. The population data proved to be accurate, and any within-city migration that may have introduced error in these reports is considered minor because of the high population of the city. The reliability of ward birth data might be called into question, yet despite the low accuracy, the precision of this data is high, suggesting that the observed "underreporting" may simply reflect the inclusion of many non-municipal births in Hamilton's vital registration.

The methods outlined in the chapter were chosen to construct the mortality profile of infants in Hamilton between 1925 and 1935. The shortcomings of the methods, where known, are clearly addressed and identified. Though not perfect, archival records are often the only source of information about the past. Although several limitations have been identified with regards to the precision and continuity of the proposed data, reliance on multiple sources discussed above allows for triangulation and thus the possibility of reconstructing the past conditions of Hamilton's population with improved accuracy.

CHAPTER IV

RESULTS

In this chapter I present the findings of my investigation of infant mortality in Hamilton (1925-35). This is done through the estimation of the infant mortality rates across the city and the comparison of the municipal rates from the plotted deaths to published rates for Hamilton, as well as to those for the country and province. In addition to the examination of the infant mortality rate, spatial analysis of infant mortality and indicators of socioeconomic status, the age structure of infant deaths, cause specific mortality and seasonal distribution of infant deaths are presented.

Infant Mortality Rates in Hamilton

The infant mortality rate (IMR) for Hamilton between 1925 and 1935, calculated using the plotted infant deaths (n = 1,792) and the official reported births (Province of Ontario Sessional Papers 1925-1935), was 54.6 per 1,000, a moderate rate based on World Health Organization statistics (WHO 2008). This rate, however, masks the annual fluctuations in IMRs as neither birth rates, nor death rates, remained stable over the decade. Additionally, since this IMR includes births to parents living outside of Hamilton, it is a conservative estimate of the true IMR in Hamilton. To correct for this, the total number of births reported in the Municipal Assessment Rolls (Hamilton Assessment Department 1927-1932) is used to generate a corrected IMR. As mentioned in the previous chapter, the birth information is only available until 1930, thus the annual number of births is estimated for 1931-35 (Assessment Roll Birth Estimates, see Table

3.4). The estimated mortality rates using these values likely overestimate the true IMRs because underreporting of births in the Assessment Rolls is suspected. These two sets of IMRs are compared to the official municipal IMRs for the study period (Table 4.1), which falls in between the two sets of estimated rates, indicating that the range of infant mortality estimated in this study is a reasonably accurate reflection of infant death in Hamilton.

National IMRs for Canada for the study period were high and averaged 94.38 for the pre-depression years and 78.42 during the depression. In comparison, Ontario as a province fared much better; the pre-depression rate was still high, 75.12, but dropped to a

Table 4.1 Estimated Infant Mortality Rates per 1,000 Live Births, Hamilton 1925-35.

Year	Births[1]	Births[2]	Plotted Deaths	Official Municipal Reported IMR[2]	Asses. Roll IMR[3]	Asses. Roll Deaths / Sessional Births IMR[4]
1925	2265	2938	203	82.03	89.62	69.09
1926	2147	2774	186	71.74	86.63	67.05
1927	2120	2866	163	65.25	76.89	56.87
1928	2362	3007	159	63.19	67.32	52.88
1929	2390	3166	187	74.23	78.24	59.07
1930	2543	3394	157	55.10	61.74	46.26
1931	*2600**	3320	152	59.04	58.45	45.78
1932	*2391**	3111	175	61.72	73.18	56.25
1933	*2144**	2864	146	56.91	68.09	50.98
1934	*2010**	2730	141	54.21	70.14	51.65
1935	*2043**	2763	123	48.86	60.20	44.52

[1] Source: Hamilton Assessment Department 1927-1932 (for births 1925-30)
[2] Source: Province of Ontario Sessional Papers 1925-1935
[3] Formula: Plotted Deaths / Ham. Asses. Dept. Births x 1000
[4] Formula: Plotted Deaths / Sessional Papers Births x 1000
* Assessment Roll Birth Estimates (see Table 3.4)

moderate level at 62.92 during the depression (Statistics Canada 1993). The lower IMR estimates for Hamilton (IMR^4, Table 4.1) indicate the IMR in this city was even lower than that for Ontario (60.99 and 49.24 for pre-depression and depression, respectively). However the higher set of IMR estimates (IMR^3, Table 4.1) suggests that the rates in Hamilton were higher than the provincial rates, particularly during the beginning of the study period and the depression years (79.74 pre-depression, 65.30 depression) (Figure 4.1). Considering that the Sessional Papers include births and deaths of infants who did not live within the city limits, I believe that the higher set infant mortality rates (IMR^3) is the best estimate.

The overall trend of IMRs for Hamilton is mostly consistent with the national and provincial data for the pre-depression period. As seen in Figure 4.1, there is a general decline in the IMR from 1926 until 1928, with an increase in 1929. Overall, the national and provincial rates decline throughout the decade. The official and estimated Hamilton rates, however, vary from this trend; although a general decline is observed in the pre-depression period, the IMRs increase during the depression years and do not return to the pre-depression rates until 1935. This indicates that although conditions related to infant health were gradually improving before the depression, they worsened in Hamilton during the Great Depression.

In order to further determine whether more strain was placed on infant health from exogenous or maternal causes, neonatal and post-neonatal mortality is assessed. The IMRs for neonates, post-neonates and stillbirths in Hamilton are shown in Figure 4.2 (for an annual by-ward distribution of neonatal and post-neonatal deaths see Appendix I).

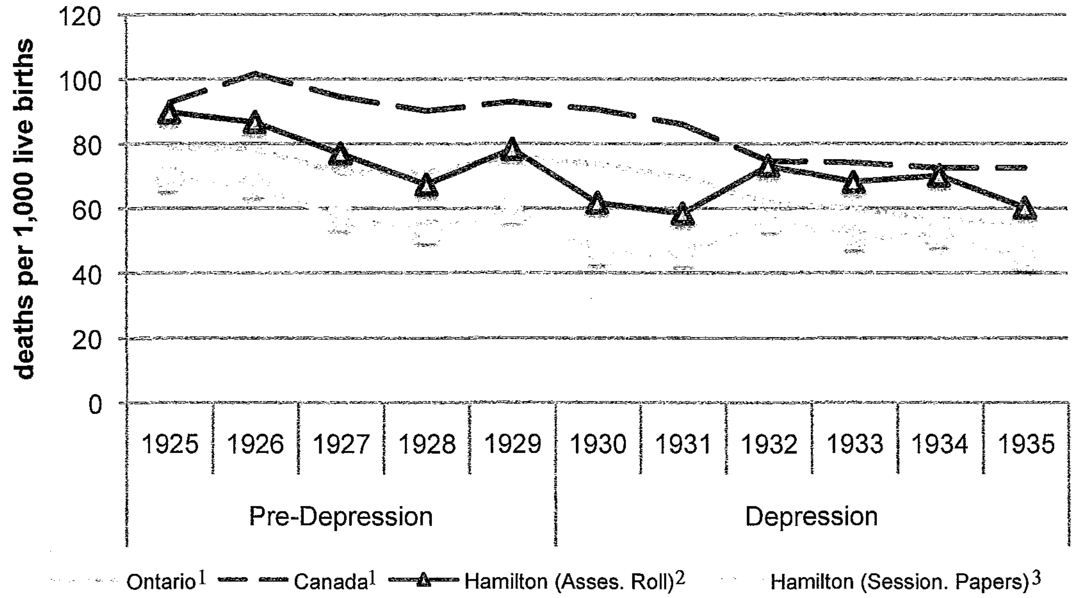


Figure 4.1 Infant Mortality in Canada, 1925-35.

[1] Source: Statistics Canada 1993
[2] Source: Hamilton Assessment Department 1927-1932 (births); estimated births for 1931-1935; plotted infant deaths
[3] Source: Province of Ontario Sessional Papers 1925-1935 (births); plotted infant deaths

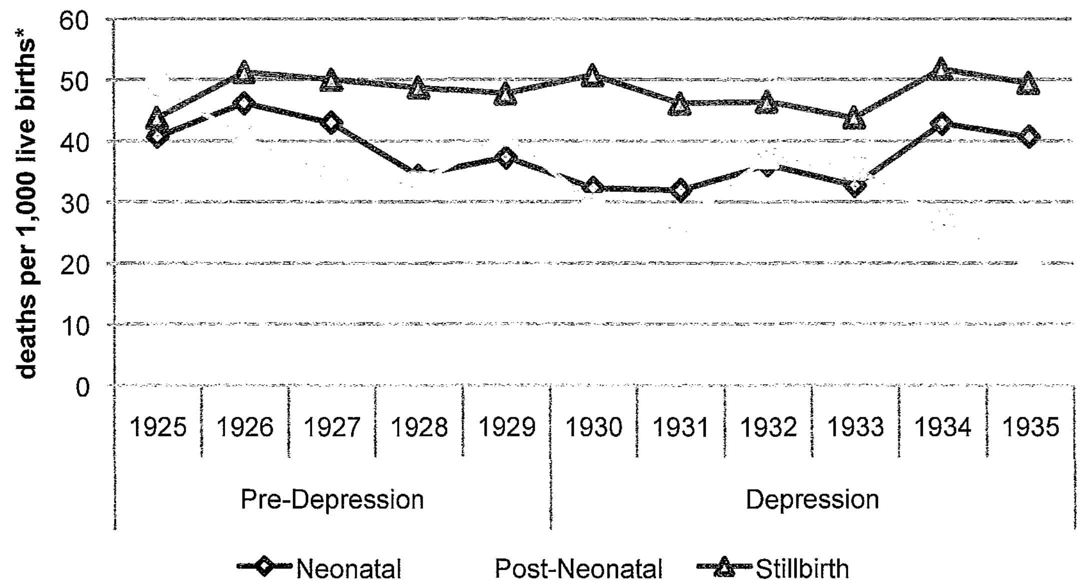


Figure 4.2 Stillbirth Rates and Neonatal and Post-Neonatal Infant Mortality Rates, City of Hamilton 1925-35.

* Source: Hamilton Assessment Department 1927-1932 (births); estimated births for 1931-1935

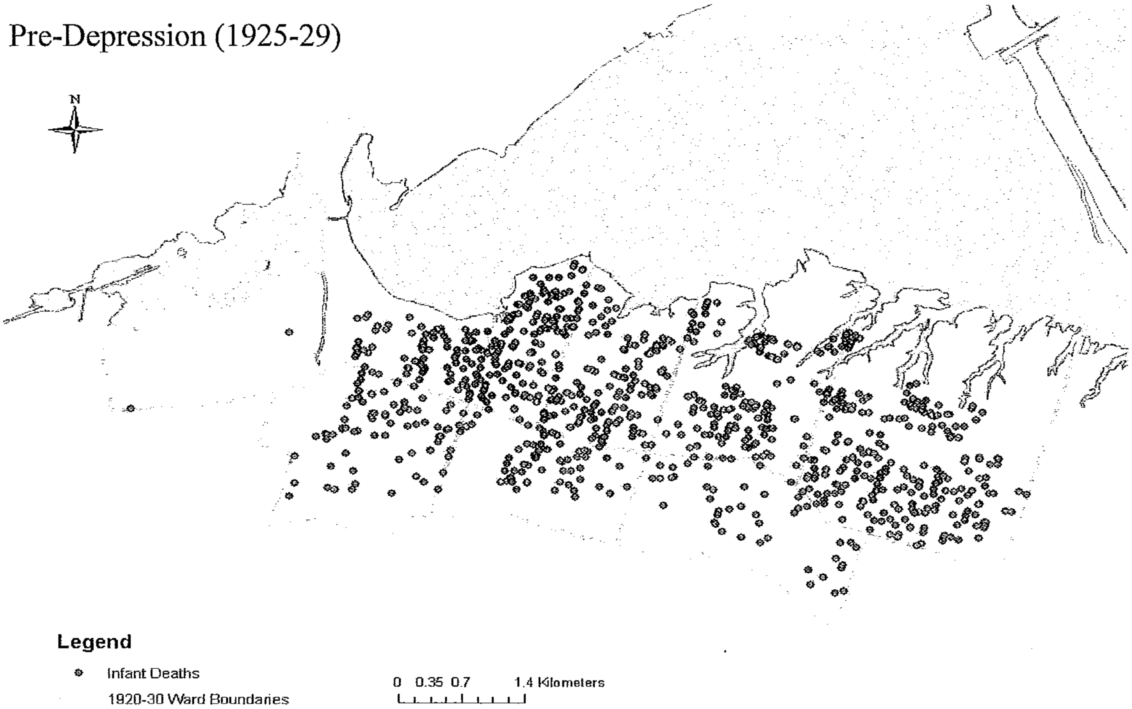
With the exception of four years (1925, 1929, 1932-33), neonatal mortality rates in Hamilton exceeded the post-neonatal rates. Overall, however, the two groups followed a similar trend throughout the decade. In the last two years of the study, 1934 and 1935, however, the neonatal mortality rate increased and post-neonatal mortality rate decreased. This suggests that for the majority of the study period, intrinsic and extrinsic forces had an equal impact on overall infant mortality, but that the cumulative effects of ongoing economic instability had a greater effect on maternal health while the post-neonatal environment was either buffered or improved altogether.

Stillbirth rates are examined to further assess maternal health and neonatal mortality. Stillbirth rates declined gradually from 1924 to 1933 and, as was the case for neonatal mortality rates, increased in 1934 and 1935. Compared to the national and provincial data, stillbirth rates were higher in Hamilton. During the pre-depression years, the average stillbirth rate in Hamilton was 36.71 per 1,000 live births, compared to 30.44 and 29.71 for Canada and Ontario, respectively, while the depression rates were 36.00 for Hamilton, 26.25 for Canada and 25.88 for Ontario (Statistics Canada 1993). This finding suggests that maternal health in Hamilton suffered during the Depression and reduced fetal and neonatal survivorship.

Spatial Analysis of Infant Deaths

The infants for whom address information was recorded on the death certificates were plotted on a city map using GIS and are shown in Figure 4.3. The figure shows that although infants died across Hamilton, there is a higher concentration of deaths in the

a. Pre-Depression (1925-29)



b. Depression (1930-35)

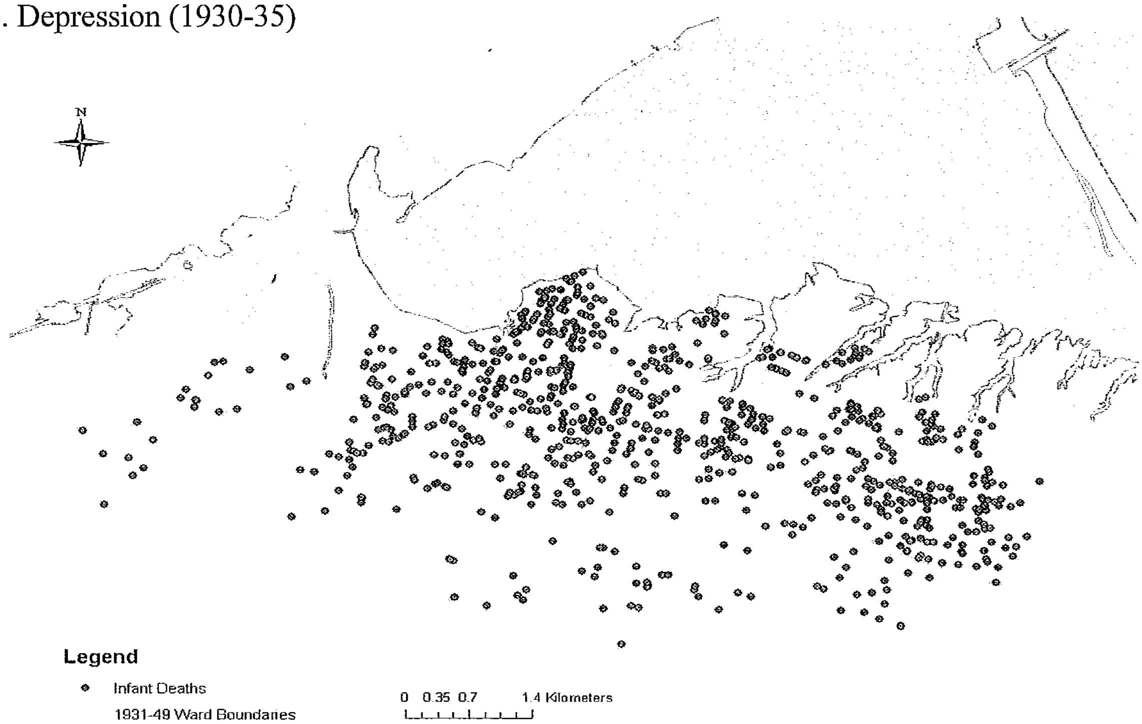


Figure 4.3 Distribution of Infant Deaths, City of Hamilton.

northern part of the city (wards 5-8) compared to the south (wards 1-3 and ward 4). In order to determine whether the observed difference is an artifact of population size or differential infant survivorship, the average pre-depression and depression IMRs for each ward were calculated using the assessment roll births for 1925-29 and an estimated number of births for 1931-35 following the procedure described earlier. Figure 4.4a shows estimated IMRs only for those families who resided at a stable home address in the city; the transients/homeless who were committed to public institutions such as infants' homes, hospitals etc. are included and shown in Figure 4.4b.

The wards affected by the inclusion of infant deaths born to homeless parents (n = 65) are wards 3, 5 and 6. The effects of the inclusion of these deaths in the IMR estimations are only significant for ward 3 for the pre-depression period ($X^2 = 4.06$, $p = 0.0440$, df = 1) (for contingency table see Appendix II, Table 1). Since the assessment roll births used for these estimates most likely do not include the homeless, the inclusion of infant deaths to homeless mothers overestimates the true IMR. Since the poorest people usually have the poorest health outcomes, the exclusion of the homeless infants in this study would erase the record of the most vulnerable members of society. It is difficult to study the health conditions of the poor and homeless because they are typically omitted in statistics; therefore their exclusion in this study would not only dismiss valuable information, but would bias the results to reflect the conditions and health of the more affluent population. Therefore the remainder of analyses (except where stated otherwise), are conducted with the inclusion of these individuals, yet the artificial inflation of infant deaths mainly in wards 3 and 5 must be taken into account when interpreting the results.

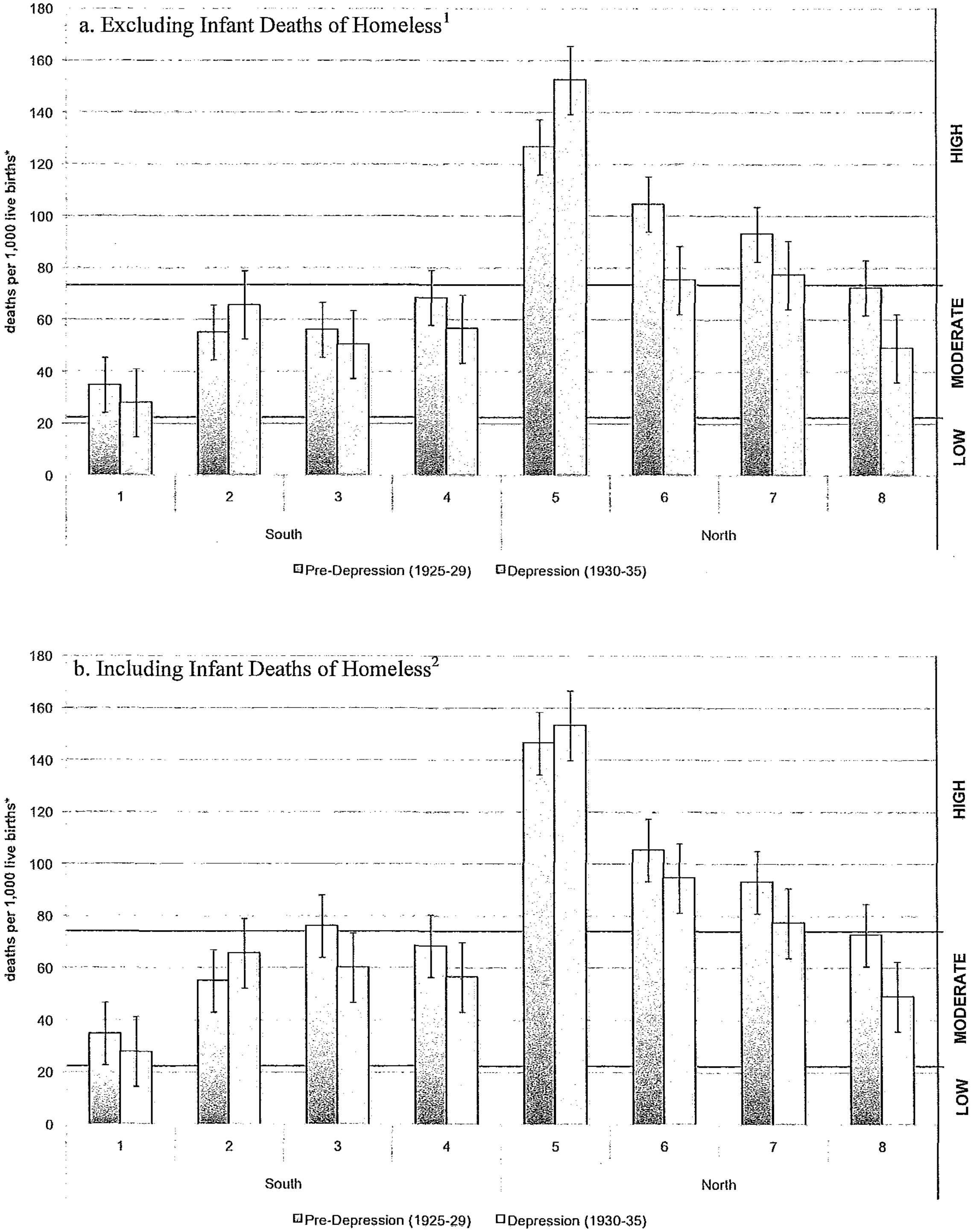


Figure 4.4 Infant Mortality Rates by Ward, City of Hamilton 1925-35.
[1] Note: $X^2 = 13.37, p = 0.0003$, df = 1, OR = 1.20 (95% CL: 1.09 < OR < 1.32)
[2] Note: $X^2 = 19.51, p = 0.0000$, df = 1, OR = 1.24 (95% CL: 1.13 < OR < 1.37)

The IMRs decrease for all wards during the depression except in wards 2 and 5. These results, however, are not statistically significant. The estimates of IMRs by ward for the two periods shown in Figure 4.4 reveal a clear distinction between the mostly southern wards (wards 1-4) and the northern wards (5-8). A Chi-Square test shows that the IMRs were significantly different between north and south for both pre-depression ($X^2 = 46.93$ $p = 0.0000$, df = 1) and depression years ($X^2 = 33.87$ $p = 0.0000$, df = 1) in Hamilton (Appendix II, Table 2). A linear representation of total IMRs comparing northern and southern wards shows that the gap between the IMRs narrows towards the end of the study period (Figure 4.5); neonatal and post-neonatal IMRs for north and south

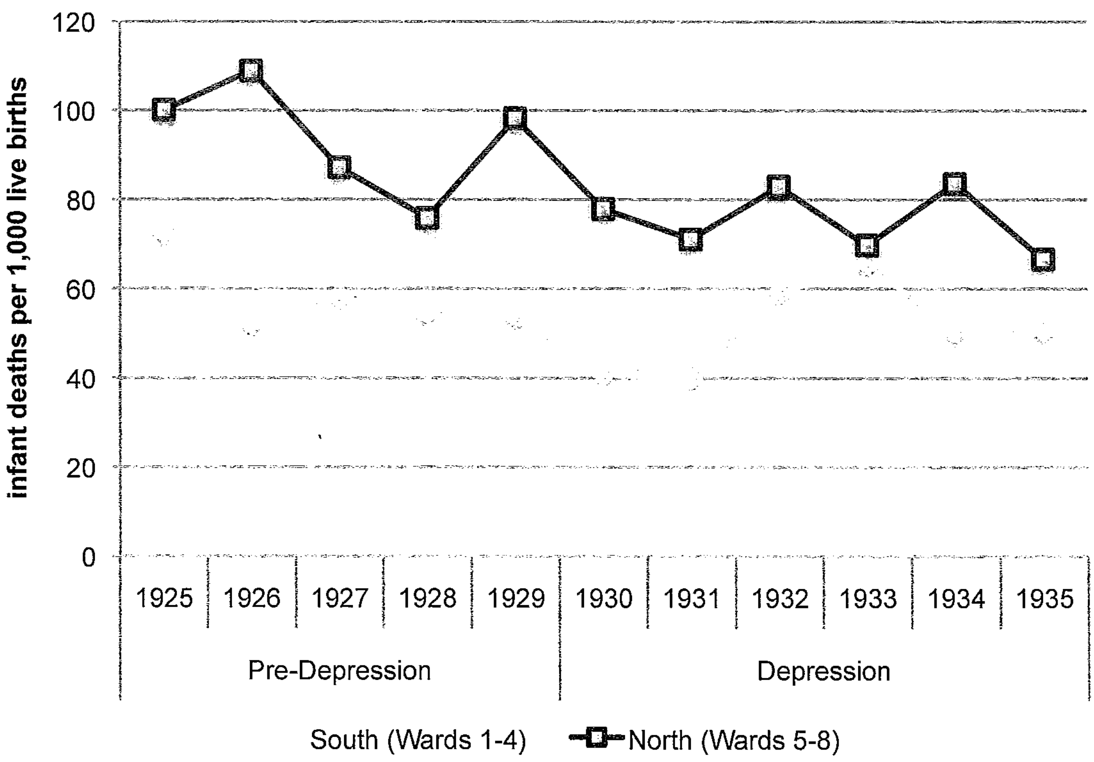


Figure 4.5 Temporal Trends in Infant Mortality Rate, North vs. South, City of Hamilton 1925-35.

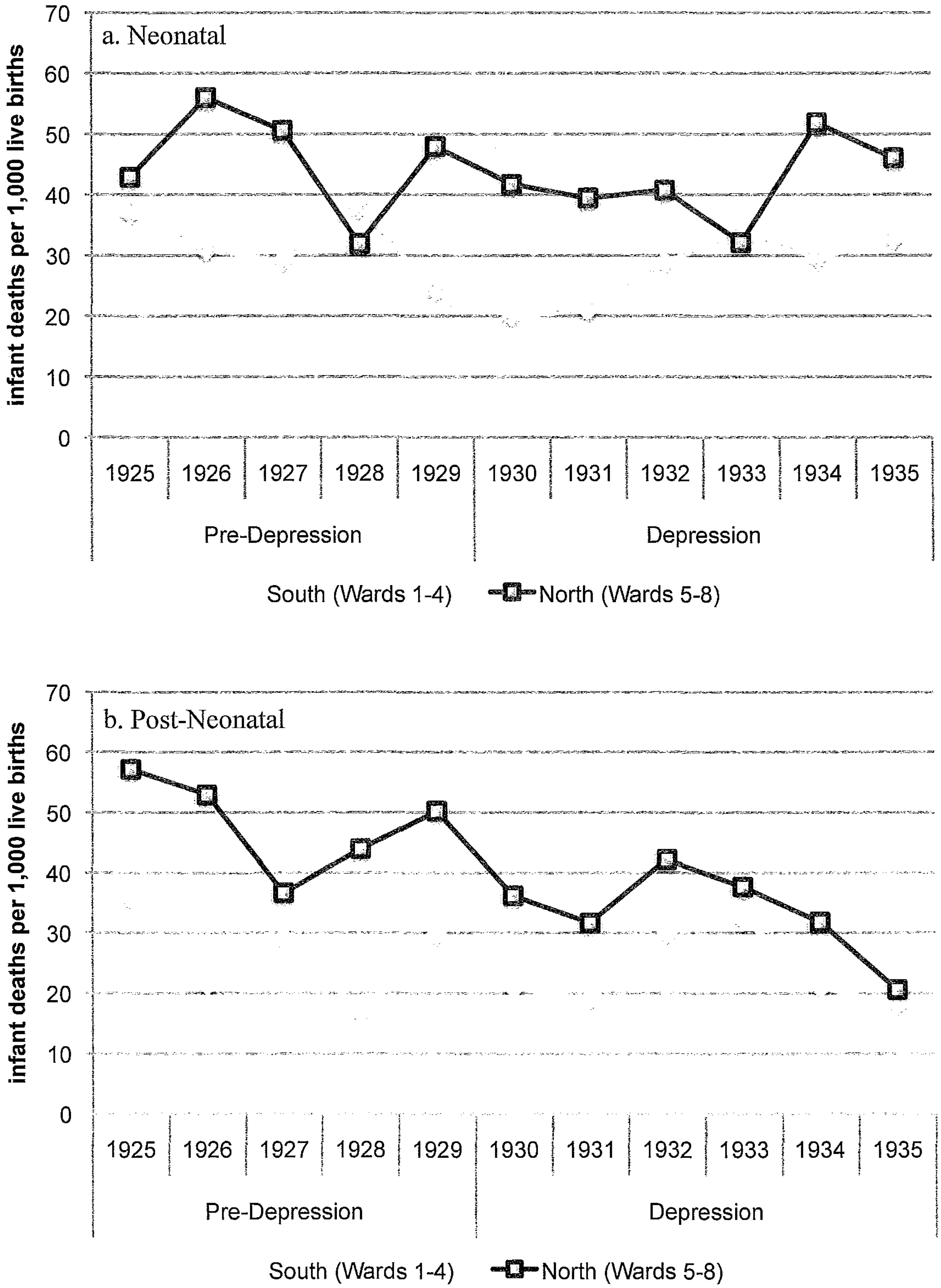


Figure 4.6 Temporal Trends in Neonatal and Post-Neonatal Mortality Rate, North vs. South, City of Hamilton 1925-35.

are shown separately (Figure 4.6). The findings for post-neonatal mortality indicate that although the infants in the northern part of Hamilton suffered disproportionately in comparison to their southern counterparts, the overall IMRs declined over the study period. A comparison of the average north and south IMRs for the two time periods supports this finding (Table 4.2), suggesting that the gap between the rich and the poor was declining and that the health of Hamilton's infants across all socioeconomic strata was steadily improving even during times of economic stress.

This relationship between north and south in neonatal mortality is different. Although 1928 and 1933 show opposite trends, where a drop in the IMRs in the north and a peak in IMRs in the south are observed, a slight U-shaped pattern exists. This indicates that the neonatal mortality rates were highest in both north and south at the beginning and end of the study period.

An analysis of death certificates for the homeless (n = 65) reveals that 23.1 percent (15 out of 65) of infant deaths whose parents were homeless occurred in the

Table 4.2 Temporal Change in Average Infant Mortality Rates, North vs. South, City of Hamilton 1925-35.

	Average IMR	**95% Confidence Limit**
Pre-Depression (1925-29)		
South (wards 1-4)	60.45	± 11.46
North (wards 5-8)	105.49	± 17.57
Depression (1930-35)		
South (wards 1-4)	53.21	± 9.18
North (wards 5-8)	89.5	± 18.24

neonatal period, compared to 52.6 percent (942 of 1,792) seen in the city as a whole. These results are surprising as they suggest that perhaps maternal health among this group is better than the overall health of the females of childbearing age in Hamilton. Since this is highly unlikely, the difference is thus attributed to under registration of infant deaths among the poor, particularly those that happened during the neonatal period.

Density

Infant mortality rate was plotted for each ward against the log of annual ward density for the study period following Woods (1984) (Figure 4.7). The results for Hamilton show an opposite trend to that reported by Woods (1984) for urban and rural England and Wales displaying a reverse fan-shaped distribution. Low population density is associated with relatively lower IMRs. As population density increases, however, greater variability in the IMRs is observed. In contrast to the relationship found in Victorian England and Wales, the infant mortality rate for Hamilton is more predictable at low rather than high population density.

The observed pattern is consistent for all wards with the exception of ward 5, where a high IMR occurs at low population density. Two conclusions can be drawn based on these findings. First, as population density increases, other intervening factors play a more significant role in the risk of infant death. Second, the association between infant mortality and population density in urban environments may be weaker in poor neighbourhoods, indicating that poverty and other factors associated with low socio-economic status have a greater impact on mortality than density alone.

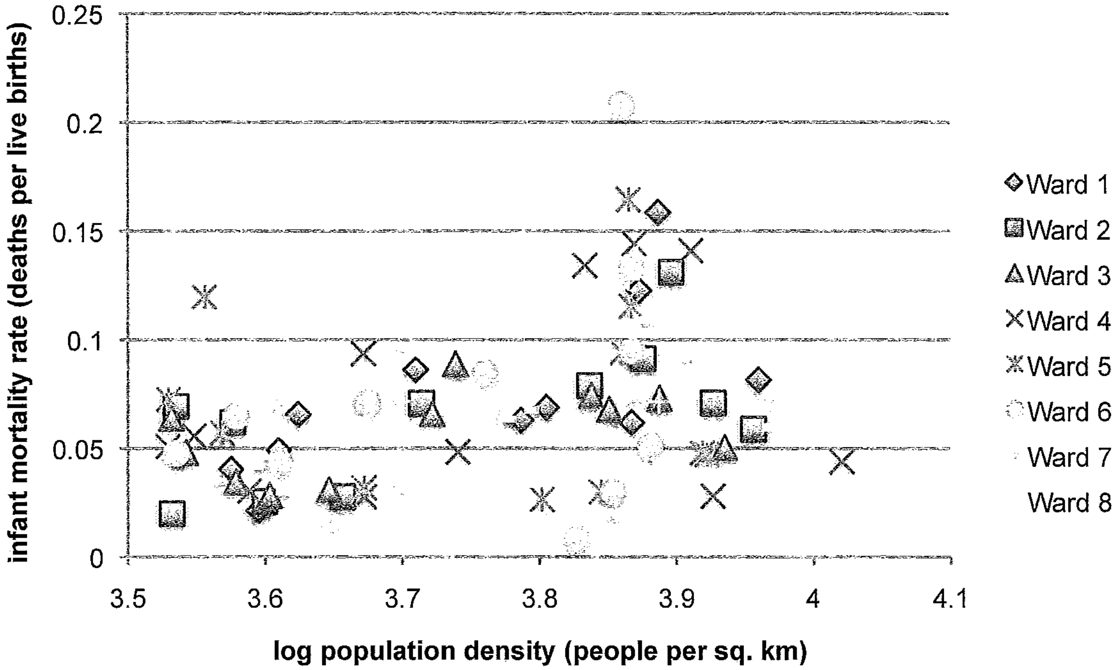


Figure 4.7 Ward Infant Mortality by log Population Density, City of Hamilton 1925-35. Source: Follwing Woods (1984)

Socioeconomic Status

Socioeconomic status by ward is quantitatively analyzed using reported infant deaths through the analysis of proportions of illegitimate births and the proportion of deaths of babies born to immigrant mothers. The rationale behind this analysis is that illegitimate births would be expected to occur more frequently among the lower social classes (Murray 1994), or would be more likely to be reported. Alternatively, illegitimate children and their parents have historically been viewed as part of the lower social classes (Davis 1939). Furthermore, immigrant status was inherently associated with low social status. Thus the spatial assessment of illegitimacy and immigrant status of infant deaths can be indicative of the general social and economic status of citizens in different wards across Hamilton.

Illegitimacy

Since infant mortality was determined to be higher in wards 5-8 compared to wards 1-4, data for this analysis are grouped according to these findings. A potential bias in the data was identified as some of the infants lived and died at charitable foundations, such as the Infant's Home and the Salvation Army Hospital, which were located in wards 3 and 5. Therefore two sets of statistical analyses (with and without homeless infant deaths) are conducted in the following analysis.

A total of 1,788 infant deaths are used to examine the spatial distribution of legitimate births. The inclusion criteria for this part of the analysis consists of all plotted deaths where at least the mother was known; all foundlings were excluded (n = 4). A Chi-Square test of proportions of legitimate births to illegitimate births[4] using mortality data before and during the Great Depression excluding homeless infant deaths (n = 61) reveals statistically significant differences ($X^2 = 6.40$ $p = 0.0114$, df = 1). When homeless deaths are included, no significant differences are observed ($X^2 = 0.03$, $p = 0.8713$, df = 1) (Appendix II, Table 3).

4 The majority of illegitimate infant deaths occurred among the homeless. A statistical comparison of legitimacy between infant deaths of homeless and non-homeless shows significant differences ($X^2 = 402.68$, $p = 0.0000$, df = 1).

Immigrants

There are 1,765 plotted infant deaths for which mother's country of birth was obtained; 27 were excluded because this information was either not provided or illegible. Immigrant status is based on whether the mother was Canadian-born or foreign-born. A Chi-Square comparison of infant deaths to Canadian versus immigrant mothers reveals a significant difference between the north and south wards in Hamilton for the study period ($X^2 = 69.62$, $p = 0.0000$, df = 1) (Appendix II, Table 4). This reveals that babies of immigrant mothers were more likely to die in the northern than in the southern wards.

An Odds Ratio calculation for all 1,765 infant deaths indicates that babies born to immigrant mothers were 1.32 times more likely to die before the Great Depression in Hamilton than babies born to Canadian mothers (95% CL: $1.09 < OR < 1.59$) (Appendix II, Table 5)[5]. These results can be interpreted to mean that overall health improved for immigrants in the years of the depression. The relative increase in the number of infant deaths to Canadian mothers during the depression, however, can mean that contrary to what is observed among the immigrants, conditions worsened for non-immigrant families between 1930-35. Although these results must remain speculative since data on births by mother's country of origin is unavailable, the IMR estimates for the southern wards during the depression support this explanation (see Figure 4.5). Moreover, historical research suggests that both explanations are correct and this point is discussed further in the following chapter.

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[5] An analysis of infant deaths of babies born to homeless mothers revealed no statistically significant differences indicating that immigrants were no more likely to be homeless than Canadian-born mothers ($X^2 = 3.24$, $p = 0.0720$, df = 1).

A further analysis of infant deaths of immigrant mothers considers the father's country of birth. The results reveal that in 80.2 percent (723 out of 901[6]) of all infant deaths to immigrant mothers, the fathers were also listed as foreign-born. This finding may suggest that infants with two foreign-born parents might have been at greater risk of mortality in Hamilton than infants with an immigrant mother and a Canadian-born father. These findings are speculative, however, as they may simply reflect a cultural or behavioural phenomenon revealing mate selection by immigrant status.

Biometric Analysis

A total of 1,769 records, where exact age at death (in days) for plotted infant deaths was known, were used to conduct the biometric analysis for Hamilton. In cases where exact date of birth or death was missing, but the month was known, a one-month range of age at death was provided on the death certificate. If the majority of that range (~85 percent) fell within a certain month category, it was included in this analysis (n = 11). For example, an infant listed as having died at age 176-207 days could be included as having died in its sixth month (151 to 181 days) or seventh month (181-211 days) of life. Since the majority of this one-month range (26 or more days) falls in the seventh month, the entry was assigned to that month. In cases where 85 percent of the one-month range did not fall in any monthly age-at-death category (i.e. less than 26 days), or age at death was unknown altogether, the entry was excluded from this analysis (n = 23).

[6] 34 were excluded because father's country of birth was not provided

The biometric method was used to determine the pattern of breastfeeding and time of introduction of complementary foods in Hamilton following Bourgeois-Pichat (1951). Comparison of the pre-depression and depression periods, which depicts the overall slopes of cumulative infant mortality within the first six months of life compared to the second half of the year, do not vary greatly (Figure 4.8). The ratios of the slopes are 0.799 and 0.782 for pre-depression and depression periods, respectively. Although these ratios are close to unity, the overall pattern of the cumulative IMRs for Hamilton indicates that infants were either never breastfed, or that the introduction of complementary foods occurred shortly after birth. Knodel and Kintner (1977) report that in Bavaria at the beginning of the twentieth century, areas where ninety percent of infants were either never breastfed or were introduced to complementary foods by three months of age, the ratio of slopes varied between 0.501 and 0.858 (403). When these data were aggregated by province, a clear distinction arose. Where little breastfeeding occurred, the ratio of slopes fell between 0.6 and 0.7; in provinces with some breastfeeding the ratios were slightly higher (0.736 and 0.932); and where breastfeeding was common, the ratios were close to and above unity (Knodel and Kintner 1977:401).

The biometric method was applied separately to wards 1-4 (south) and wards 5-8 (north) in Hamilton. The results are presented in Table 4.3. Although the same pattern of early weaning is observed in the different sections of the city before and during the Great Depression, one main difference is noted: the ratio of slopes for wards 1-4 (south) is lower than that observed in wards 5-8 (north). This suggests that although lack of breastfeeding (or early weaning) was seen across the whole city, it was much more

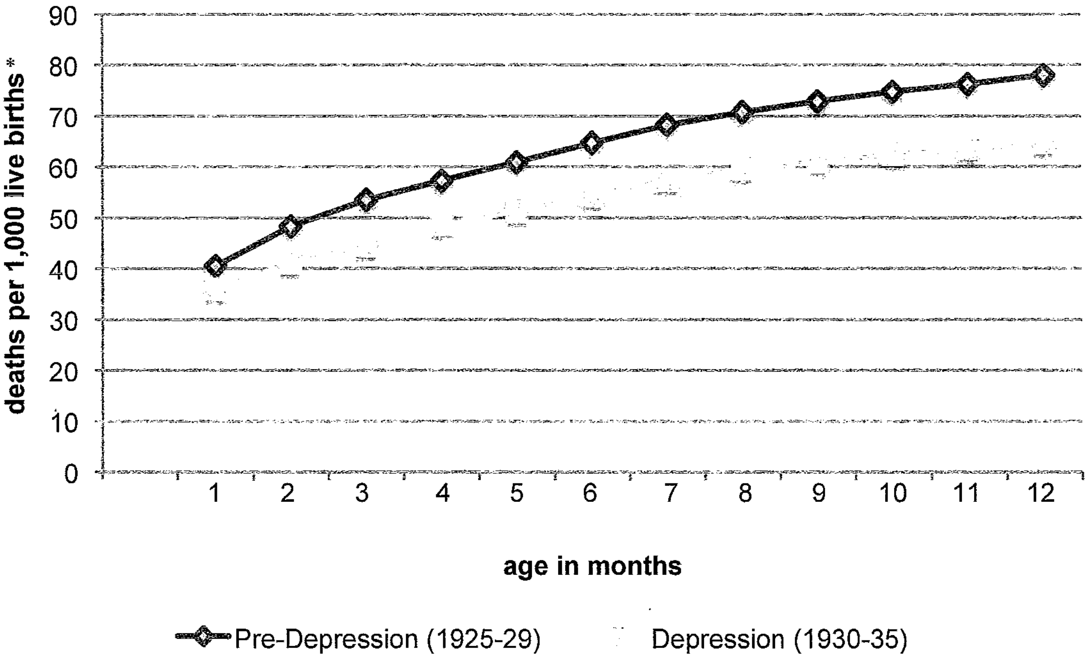

Figure 4.8 Infant Deaths by Age using the Biometric Method, City of Hamilton 1925-35 (n=1,769).

* using assessment roll births for 1925-30 and estimated births for 1931-35

Table 4.3 Infant Deaths by Age by Wards, Ratio of Slopes using the Biometric Method, City of Hamilton Wards 1925-35 (n = 1,769).

	cumulative infant deaths per 1,000 live births by age in days			slope		**Ratio of slopes**
	1 mo	6 mos	12 mos	1-6 mos	6-12 mos	
Wards 1-4						
Pre-Depression (1925-29)	31.62	48.76	57.00	0.020	0.011	**0.567**
Depression (1930-35)	27.16	42.07	50.24	0.018	0.012	**0.653**
Total (1925-35)	**29.14**	**45.04**	**53.24**	**0.019**	**0.012**	**0.613**
Wards 5-8						
Pre-Depression (1925-29)	46.37	75.22	91.86	0.034	0.030	**0.889**
Depression (1930-35)	42.11	62.86	74.83	0.024	0.021	**0.849**
Total (1925-35)	**44.05**	**68.50**	**82.60**	**0.029**	**0.025**	**0.870**

prominent in the southern part of Hamilton. This outcome was consistent through time, however the difference between the ratios of north and south Hamilton is slightly greater before the depression. The ratio of the slopes also increased during the depression in the south, possibly indicating that breastfeeding was prolonged there, whereas in the north the opposite trend was observed suggesting that introduction of complementary foods during the Depression occurred earlier in wards 5-8 than during the pre-depression period.

Cause of Death

The infant mortality by age analysis indicates that a slightly higher proportion of deaths occurred within the first six months of life in Hamilton. To determine whether this could be attributed, as suggested by the biometric method, to patterns of breastfeeding, the causes of infant deaths are analyzed. Following the criteria outlined in the previous chapter, 1,827 causes of death were used in this part of the analysis. (For the list and classification of cause of death data see Appendix III). Following McKeown's (1976) system of disease classification, the total infant deaths for Hamilton by cause are represented in Figure 4.9 and Table 4.4. The leading cause of death among infants in Hamilton for both the pre-depression and depression years was listed as congenital causes[7]. The second highest cause of infant mortality was due to airborne or respiratory infections.

[7] Among the homeless (n = 70) the leading cause of death was due to airborne infectious diseases (34.3%) followed by gastro-intestinal infections (25.7%). Congenital factors were the third most listed cause. Its relatively low frequency is most likely a result of underreporting of infant deaths among the homeless.

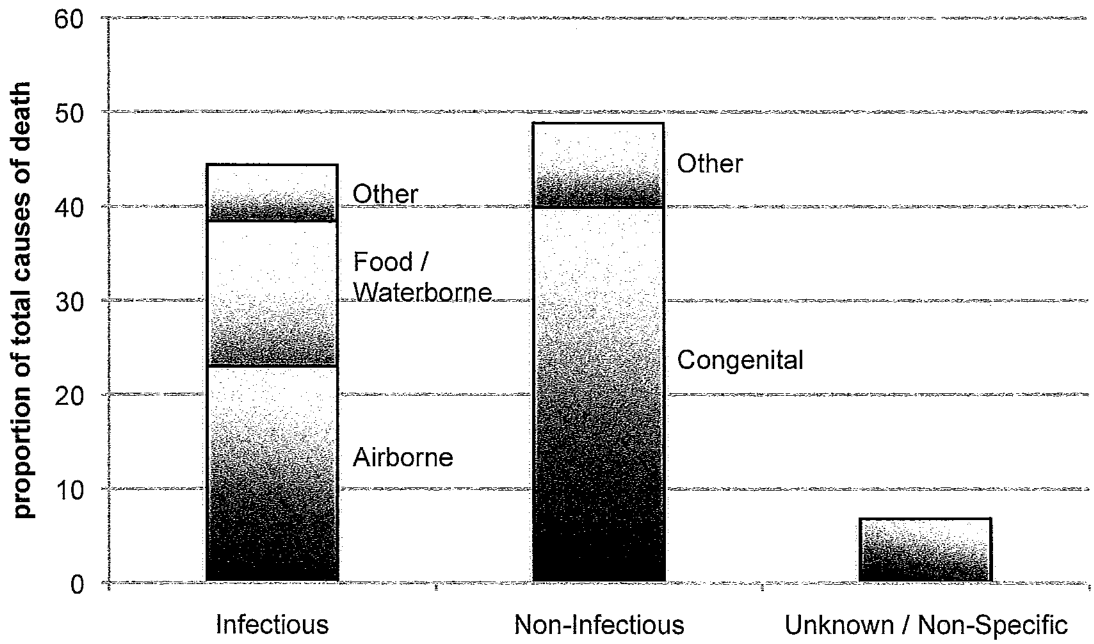

Figure 4.9 Causes of Infant Mortality in Hamilton, 1925-35 (n = 1,827).

Table 4.4 Cause of Infant Mortality by Wards, City of Hamilton 1925-35 (n = 1,827).

	INFECTIOUS			NON-INFECTIOUS		UNKNOWN/
	Airborne	Food / Waterborne	Other	Congenital	Other	NON-SPECIFIC
Number of Deaths						
Pre-Depression	208	157	49	359	87	68
Depression	212	124	60	369	77	57
Total:	**420**	**281**	**109**	**728**	**164**	**125**
Proportion of Deaths (%)						
Pre-Depression	22.41	16.92	5.28	**38.69**	9.38	7.33
Depression	23.58	13.79	6.67	**41.05**	8.57	6.34

Statistical analysis indicates that there was no difference in the proportion of infant deaths due to infectious and non-infectious causes in Hamilton for the study period[8] ($X^2 = 0.23, p = 0.6306$, df = 1) (Appendix II, Table 6). A comparison of the proportion of infant deaths between northern and southern wards shows no significant differences due to infectious ($X^2 = 0.06, p = 0.8128$, df = 1) or congenital ($X^2 = 0.20, p = 0.6563$, df = 1) diseases for the death cohorts (Appendix II, Table 7).

Because exogenous causes of infant death are best used to assess the quality of the child's environment and living conditions (McKeown 1976), the analysis now turns to infectious diseases. Although no differences in the number of deaths due to specific infectious diseases were observed for the pre-depression and depression periods across the city, this can mask the actual cause specific infant mortality rate. Therefore the annual infant mortality rates for airborne and food/waterborne infectious diseases (leading causes of post-neonatal mortality) are estimated and presented in Figure 4.10.

The IMRs due to respiratory infections are significantly higher for the north than the south for both pre-depression ($X^2 = 14.66, p = 0.0001$, df = 1) and depression ($X^2 = 21.53, p = 0.0000$, df = 1) cohorts (Appendix II, Table 8). The IMRs in the northern wards present a pattern with biennial peaks throughout the study period. Although the overall temporal trend is one of decline, the differences are not statistically significant ($X^2 = 1.49, p = 0.2226$, df = 1) (Appendix II, Table 9a). In the southern wards, the declining trend in infant mortality rate due to respiratory infections ends with an increase during the

[8] Unknown and non-specific causes excluded (n = 125).

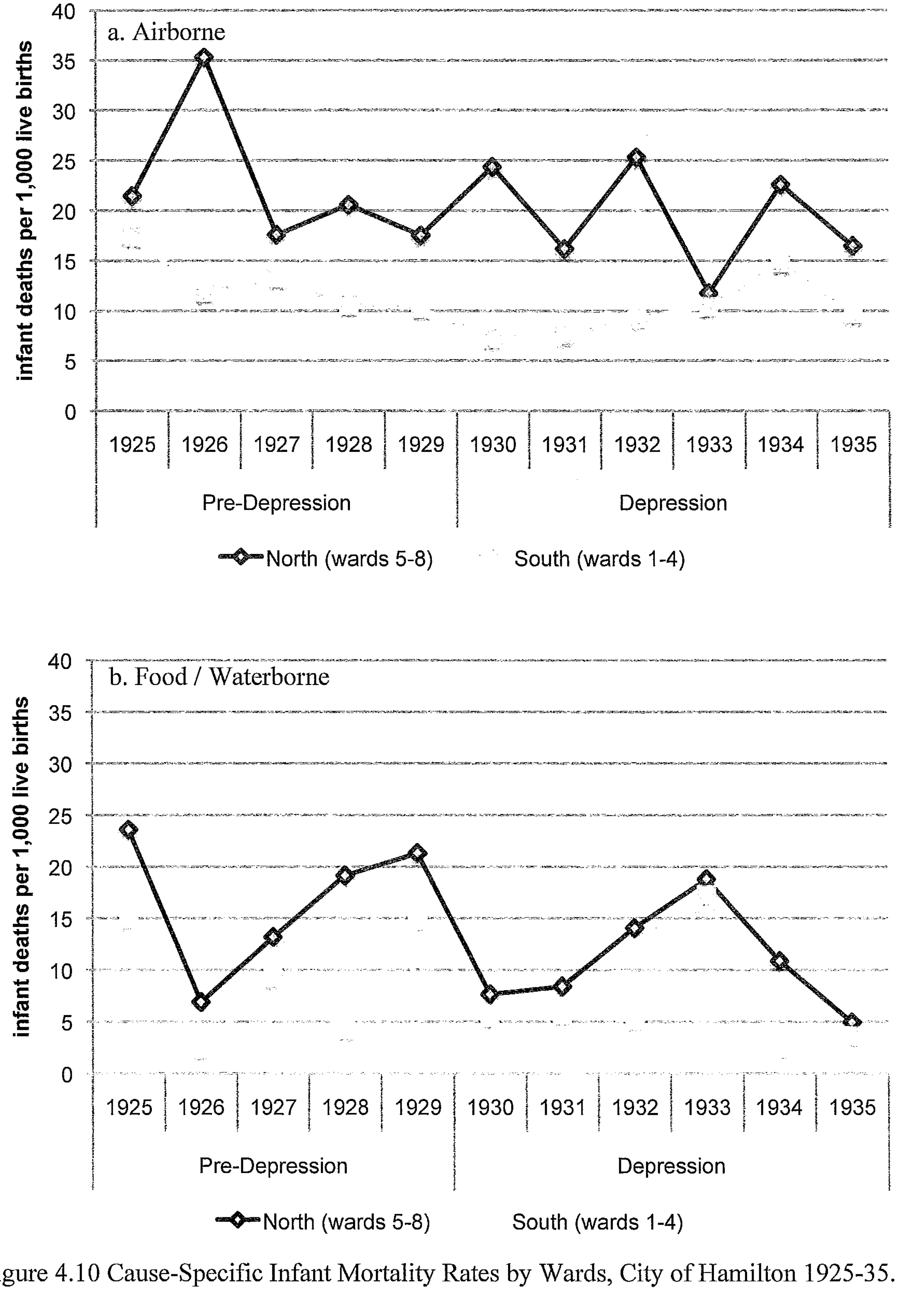

Figure 4.10 Cause-Specific Infant Mortality Rates by Wards, City of Hamilton 1925-35.

depression years (1932-34), however there is no significant change in the IMRs when comparing the two death cohorts ($X^2 = 1.93, p = 0.1645$, df = 1) (Appendix II, Table 9b).

The analysis of IMRs for deaths due to food and waterborne infections indicates a significant difference in the rates between the north and south wards for both death cohorts (pre-depression: $X^2 = 34.34, p = 0.0000$, df = 1; depression: $X^2 = 20.32, p = 0.0000$, df = 1) (Appendix II, Table 10). There are three years of peak mortality in the north from diarrheal diseases: 1925, 1929 and 1933. These peaks, although lower in magnitude, are mirrored in the southern wards. A comparison of the IMRs for death cohorts shows a statistically significant decline for the northern wards ($X^2 = 10.56, p = 0.0012$, df = 1) (Appendix II, Table 11a); no differences are observed in the south[9] ($X^2 = 1.82, p = 0.1769$, df = 1) (Appendix II, Table 11b).

The factors explored in this analysis indicate that although it was one of the leading causes of post-neonatal death, respiratory infections did not greatly impact overall IMRs, especially in the southern wards. Food and waterborne infectious disease, however, was a much greater cause for concern of infant health, as it even impacted infants in the more affluent southern wards. A significant decline in IMRs from gastro-intestinal infections was observed over the study period in the northern wards, and by the mid-1930s, mortality rates dropped to their lowest levels and were equal to those seen in the south. The results presented here further indicate that health conditions in Hamilton were improving for the rich and the poor alike.

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[9] The cause specific IMR for food/waterborne infections in 1933 is significantly higher than the rest of the depression years in the south ($X^2 = 18.05, p = 0.0000$, df = 1).

Seasonality

The seasonal neonatal, post-neonatal and total IMRs during the pre-depression and depression years are presented in Figure 4.11. In addition to simply presenting the IMRs, an index value is provided for the infant deaths during the two time periods of interest (Figure 4.12). It is evident that in Hamilton a seasonal difference in the risks of infant death is observed. Additionally, there are slight differences in seasonal mortality risk before and during the depression. In the years leading up to the economic crash, mortality risk was high from mid- to late winter until early to mid-spring and very high in late summer to early fall (with a peak in September). During the Great Depression, however, mortality risk was higher during the spring, with peaks at the beginning and end of the season, and was very high in early to mid-fall, with a peak over 50 percent of the average mortality risk in October alone.

A Chi-Square test of seasonal IMRs revealed that the differences were statistically significant for both pre-depression ($X^2 = 16.71$, $p = 0.0008$, df = 3) and depression ($X^2 = 28.30$, $p = 0.0000$, df = 3) cohorts (Appendix II, Table 12). Analyses of differences in IMRs by death cohorts for individual seasons were significant for all seasons except fall ($X^2 = 0.16$, $p = 0.6895$, df = 1) (Appendix II, Table 13). Since IMRs declined over the depression period, the differences were expected; the lack decline in infant mortality in the fall was surprising. Although differences were found in the IMRs, the proportions of deaths by season did not significantly differ, however a statistically significant increase in the seasonal proportion of infant deaths during the depression was observed in the fall ($X^2 = 5.80$, $p = 0.0160$, df = 1) (Appendix II, Table 14).

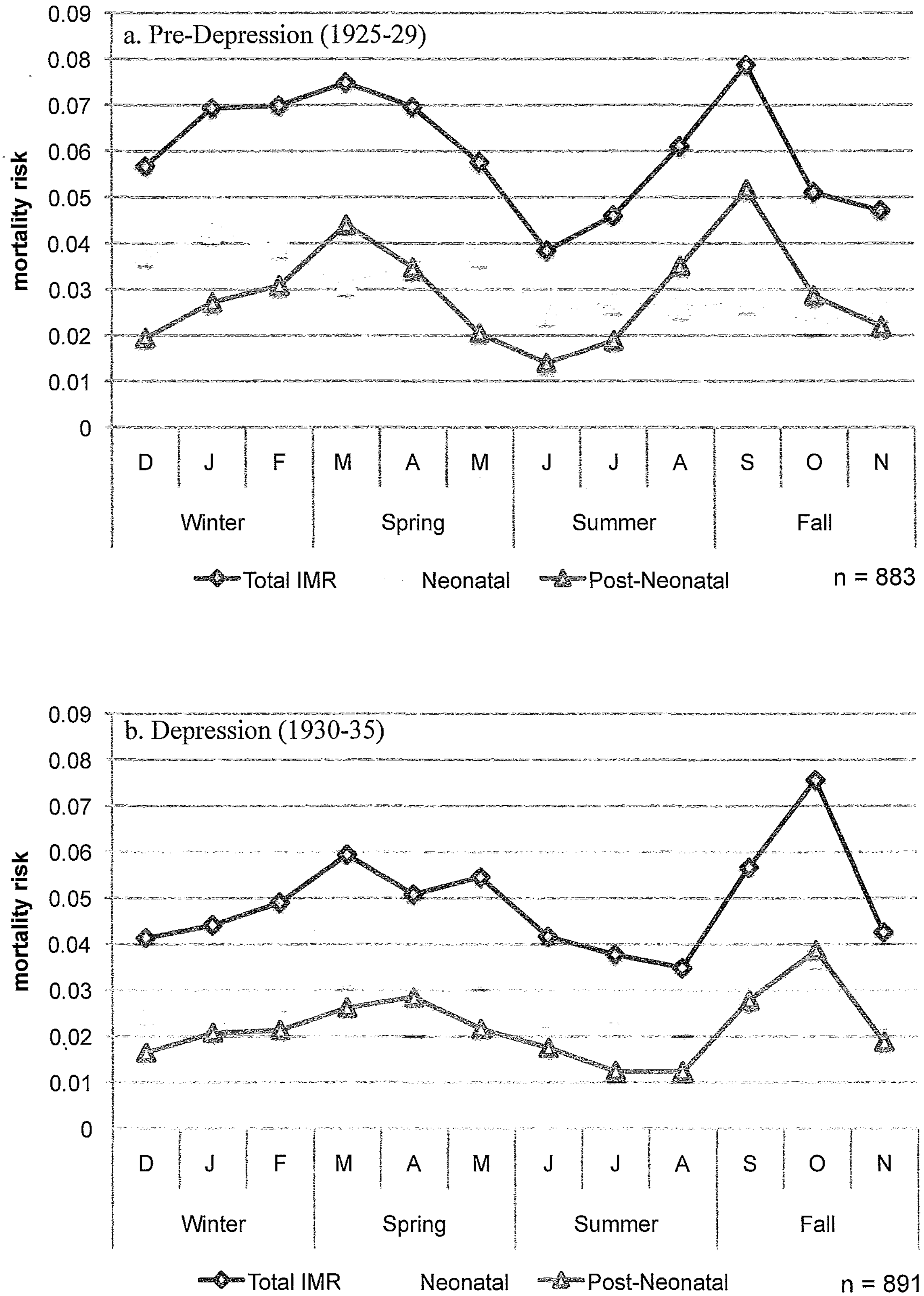


Figure 4.11 Seasonal Trends in Infant Mortality Risk, City of Hamilton, 1925-35.

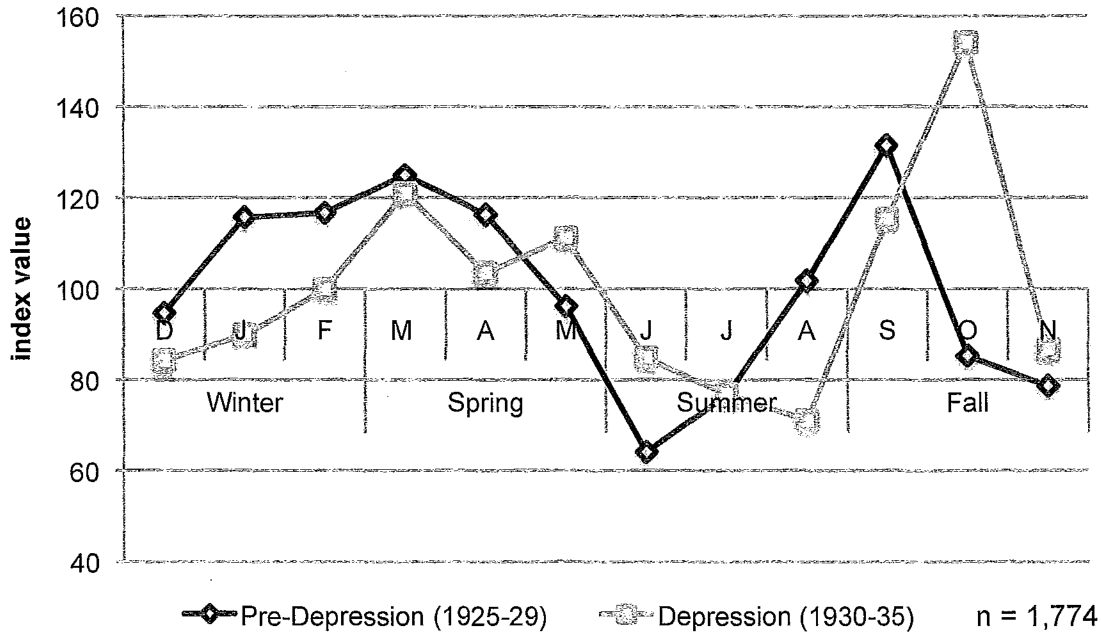


Figure 4.12 Index of the Monthly Variation in Mortality Risk, City of Hamilton, 1925-35.

The results observed in the fall season during the depression period were anomalous and unexpected. Upon closer examination, it was noted that an unusual peak in infant mortality occurred in October 1933 (IMR = 181.82, compared to annual average IMR = 50.98 for 1933[10]). Since this excess infant mortality was thought to disproportionately contribute to the calculations, the statistical tests for differences in seasonal IMRs and proportions of seasonal deaths were repeated without the 1933 data. These calculations resulted in no significant differences for IMRs ($X^2 = 2.60$, $p = 0.1071$, df = 1) (Appendix II, Table 15) or for proportion of seasonal deaths ($X^2 = 0.04$, $p = 0.8508$, df = 1) (Appendix II, Table 16) between the pre-depression and depression

[10] using plotted deaths and reported births (Province of Ontario 1933)

periods, which indicates that although the infant deaths for October 1933 contributed to the proportional number of seasonal infant deaths, it did not skew the seasonal IMR data. Overall, the IMR for fall during the Great Depression is considerably higher than expected since, unlike the rest of the seasons, no significant temporal decline was observed.

Since neonatal mortality is understood to be caused predominantly by intrinsic factors, a focus on post-neonatal mortality follows to get an insight into extrinsic causes of seasonal mortality (Table 4.5). The causes of post-neonatal deaths during the peak seasons when mortality risk was highest[11] are consistent with other demographic trends from the late nineteenth / early twentieth century. Before the depression (1925-29), the leading cause of post-neonatal deaths in mid- to late winter / early to mid-spring (January-April) was respiratory infections (59.1% of seasonal deaths) followed by infectious other causes of death (12.2%). Food and waterborne infectious diseases, however, were not uncommon during this time (11.6%). During late summer / early fall (August-September), the leading cause of death was attributed to food and waterborne infections (66.1%) followed by respiratory infections (16.9%).

The leading causes of death among post-neonates for the peak months (March-May and September-October) during the time of the depression (1930-35) did not change seasonally in comparison to the pre-depression cohort, but other causes seemed to be more significant in the overall mortality profile. For deaths occurring in the spring (March-May), 59.0% of those were caused by respiratory infections, followed by food

[11] index value greater than 100

Table 4.5 Seasonal Post-Neonatal Mortality by Cause of Death and Death Cohort, City of Hamilton 1925-35.

	INFECTIOUS			**NON-INFECTIOUS**		**UNKNOWN/**
	Airborne	Food / Waterborne	Other	Congenital	Other	**NON-SPECIFIC**
Number of Deaths						
Pre-Depression (1925-29)						
Winter	53	14	13	6	12	6
Spring	79	16	14	6	15	4
Summer	24	44	5	4	9	2
Fall	32	80	9	8	16	3
Total:	**188**	**154**	**41**	**24**	**52**	**15**
Depression (1930-35)						
Winter	47	9	11	6	9	8
Spring	59	9	21	6	17	5
Summer	32	19	8	4	5	3
Fall	40	73	6	8	11	6
Total:	**178**	**110**	**46**	**24**	**42**	**22**
Proportion of Deaths (%)						
Pre-Depression (1925-29)						
Winter	**50.96**	13.46	12.50	5.77	11.54	5.77
Spring	**58.96**	11.94	10.45	4.48	11.19	2.99
Summer	27.27	**50.00**	5.68	4.55	10.23	2.27
Fall	21.62	**54.05**	6.08	5.41	10.81	2.03
Depression (1930-35)						
Winter	**52.22**	10.00	12.22	6.67	10.00	8.89
Spring	**50.43**	7.69	17.95	5.13	14.53	4.27
Summer	**45.07**	26.76	11.27	5.63	7.04	4.23
Fall	27.78	**50.69**	4.17	5.56	7.64	4.17

and waterborne infections (11.9%) and other non-infectious causes (11.2%). In the fall (September-October) food and waterborne infectious disease remained the leading cause of death (60.0%) again followed by respiratory infections (20.9%).

Results of the analysis of *monthly* post-neonatal deaths follow expected trends, yet combined seasonal trends reveal a curious pattern. Overall seasonal post-neonatal deaths before the depression in winter and spring were primarily caused by respiratory infections, and in the summer and fall deaths were due to gastrointestinal infections. The depression data, however, deviate from this pattern slightly in the summer, as infant deaths after the first month of life are due to respiratory, rather than gastrointestinal, infections (see Table 4.5).

Conclusion

Due to the lack of birth data for Hamilton during the study period, the analysis of infant mortality proved to be somewhat limited and problematic at times. Births of babies whose parents were not citizens of urban Hamilton were very likely included in the calculations, therefore the results presented in this study must be viewed with caution. Additionally, the estimates of the number of births for wards during the depression years may be inaccurate as the estimates were derived under the assumption that birth rates were stable over time, and that the proportion of births by ward remained fixed from the pre-depression period. The limited birth data available from the Municipal Assessment Rolls, however, proved to be indispensible as its availability allowed for more in-depth analysis.

The decline in the IMRs over the study period was consistent with mortality trends observed throughout the twentieth century. It was surprising, however, to find that even though the IMRs did increase slightly during the first few years of the Great Depression in Hamilton, the average for the period remained significantly lower compared to the pre-depression years. A further look into neonatal and post-neonatal mortality revealed that for most of the years both intrinsic and extrinsic factors were affecting infants equally. A rise in post-neonatal mortality was observed at the beginning of the depression with no significant change to neonatal mortality rates; however during the last two years of the study period (1934 and 1935), neonatal mortality increased and post-neonatal mortality declined. An analysis of stillbirths supported the finding that the Great Depression had a greater effect initially on the post-neonatal environment and, as it progressed, the impact shifted to factors affecting maternal rather than post-neonatal health.

The analyses of infant mortality offer insight into the overall quality of health of the population of the city, however the results presented here cannot be taken as conclusive without further synthesis and contextualization. A discussion of the results framed around the social conditions found within Hamilton is presented in the following chapter.

CHAPTER V

DISCUSSION AND CONCLUSIONS

The focus of this study is to examine the patterns of infant mortality in Hamilton and the economic impact of the Great Depression on people's health using the theoretical frameworks of critical medical anthropology and New Social Medicine. I strive to determine how, and why, the economic crisis affected infant mortality rates. Perhaps the more compelling issue relates to equality in health status and the experience of disease. Who suffered most in Hamilton and why? The answers to these questions are complex and overlap. I spend the remainder of this thesis exploring these ideas and conclude with the new questions that emerged during this process of analysis and reflection.

Differential Patterns in Infant Mortality and Inequality

Using infant mortality as a proxy for population health, it becomes very clear that in Hamilton the burden of poor health was not shared equally by all individuals across the city. According to the estimates for wards in the north (wards 5-8), the infant mortality rate for the working-class ranged from 105.49 in the pre-depression period to 89.5 during the depression years, considerably higher than the national (94.38 and 78.42) and provincial (75.12 and 62.92) rates. The estimates for the working class in Hamilton, and for Canada overall, are very high according to the World Health Organization and fall within the same range as the poorest developing nations today (2008). In contrast, the IMRs for the middle- and upper-class in Hamilton fall into the moderate category. These estimated rates for the more affluent wards (wards 1-4) were significantly lower than those for the northern wards in Hamilton as well as the national and provincial rates, at 60.45 and 53.21 for the pre-depression and depression years, respectively. Based on these estimates one can conclude that the labourers in Hamilton suffered disproportionately from ill health. These results closely echo the data for the United States, where Meckel (1990) reported higher infant mortality rates for the same time periods among non-whites in comparison to the white American population. Why, under the same economic conditions, would some families, in these cases categorized in one way or another as 'foreign' or 'other', experience more death and disease? And did all working-class citizens, foreign-born or Canadian, equally share this burden?

The history of immigration is fraught with inequality and stigma associated with being 'foreign' in the Americas. This was equally true for Hamilton. Drawn by economic growth of the industrial revolution, many moved from Europe in hopes of having a better life. Even when the city was in its infancy, the migrant families were shunned both explicitly and implicitly. The obvious prejudice was faced when immigrants were, often inaccurately, branded as carriers of disease (Kraut 1994; Janjua 2007; Brunton 2008). This stigma led to the physical and intentional segregation of the immigrant groups in Hamilton in the city's northern wards. Furthermore, during the development of the housing industry in the 1920s, social control was exercised by including in the deeds limitations on who could and could not purchase land in certain neighbourhoods. The clause read: "None of the lands described…shall be used, occupied by or let or sold to Negroes, Asiatics, Bulgarians, Austrians, Russians, Serbs, Rumanians (sic), Turks, Armenians, whether British subjects of not, or foreign-born Italians, Greeks, or Jews" (quoted in Doucet and Weaver 1991:123).

The inconspicuous and less intentional partition of immigrants from the middle-class was inherent in the economic forces driving the cycle of migration. In the early twentieth century, a person's occupation had great influence on one's social status, perhaps even to a greater extent than today. The type of resources one had access to were dependent on both one's status and income. Thus a labourer living in Hamilton could not afford to live far from where he worked, which was usually in the factories located along the harbour. As a result, housing and living conditions were also directly linked to occupation.

This relationship between occupation and housing is not necessarily clear. As demonstrated, some of Hamilton's neighbourhoods where labourers and immigrants were disproportionately clustered, classified as wards, showed a decline in infant mortality almost equal to that seen in the more affluent parts of town by the 1930-35 period. More specifically, the only ward where mortality rates remained very high and even increased was ward 5; infant mortality in almost all other immigrant wards declined to moderate levels. What were the factors that influenced these changes? Was it, as Kunitz (2007) would suggest, a decline in the inequity of income distribution, McKeown's (1976) argument of improved nutrition due to better living standards, or do these patterns reflects environmental differences based on location rather than specific class differences (Reid 1997:151)? In order to answer this question, the discussion now turns to the cause-specific mortality of Hamilton's infants.

Cause of Infant Deaths

The three leading causes of infant death during the study period were congenital causes, followed by respiratory and intestinal infections. Neonatal deaths, mostly caused by congenital factors, declined for both north and south Hamilton in the pre-depression period, but steadily increased throughout the depression. Pre-natal and perinatal care in Hamilton and Canada at this time in history was in its infancy. Although some pre-natal clinics were set up in the city, attendance was low. For example, in 1928 the attendance at clinics was 152 of 2,792 pregnancies reported by the Health Department; in 1929 attendance increased slightly to 176 (Hamilton Health Association 1928-29). Furthermore, hospitalization of births and infant care was only starting to become popular at that time and was more common among the middle-class (Mitchinson 2002; Comacchio 1993). It is therefore not surprising that the neonatal mortality rate for these years did not decline. Its increase, however, suggests that maternal health deteriorated during the depression.

Considering the trends of declining post-neonatal mortality rates in the pre-depression period, the peaks in infant mortality in 1933 due to respiratory and intestinal infections indicate a worsening of environmental conditions responsible for exposure to and transmission of these diseases in the worst documented year of the Great Depression. The fact that rates were almost identical in this year for both middle- and working-class neighbourhoods suggests that even the more affluent families were not immune to the effects of the depression. Furthermore, overall post-neonatal mortality trends for both areas of Hamilton in the 1925-29 period were declining; the sudden break in this trend in

1932-33 further supports the hypothesis of a decline in the post-neonatal environment in the years of the worst economic conditions.

Average seasonal mortality patterns of infants due to extrinsic factors in Hamilton reflect the classic late eighteenth and early nineteenth century models of excess mortality from respiratory diseases in the cold winter months and increased mortality from diarrheal diseases in the hot summer months in the pre-depression period. A seasonal shift in cause-specific mortality was observed in the depression years where airborne infections became the leading cause of summer infant deaths. Additionally, a significant decline in seasonal infant mortality rates was identified between the death cohorts for all seasons except fall, indicating that infants were most likely to die from exogenous causes in the fall months during the Great Depression.

Respiratory infections are commonly known to propagate in cold environments as well as environments where air temperature changes suddenly from warm to cold (Howe 1997:173), which happens with the change of seasons, particularly winter-spring. These types of infections are more common in industrial towns, especially where pollution is highest (Lunn et al. 1967:15) and where the air can be characterized as "damp and smoky" (Howe 1997:173). Additionally, exclusive breastfeeding has been known to offer immunological protections specifically from respiratory infections during the first four months of life (Forman et al. 1984:451) as well as intestinal infections (MacMurchy 1910). Because biometric results indicate that breastfeeding rates were low and complementary foods were introduced in early infancy, this could potentially explain the high proportions of deaths due to these infectious diseases. It does not, however, explain the summer deaths from respiratory infections that were observed during the first half of the Great Depression in Hamilton.

Peiris et al. (2003) discovered that a recently identified virus, the human metapneumovirus (HMPV), causes a peak in respiratory infections among individuals under 18 years of age during the spring-summer in Hong Kong. They note, however, that HMPV in temperate regions has reportedly showed peak activity during the winter-spring seasons only (631). Additionally, human parainfluenza virus, known to commonly cause respiratory infections in young children, is responsible for increased annual incidence in respiratory infections in the United States during the spring and summer (parainfluenza virus type 3) (Hall 2001:1917; Griffin et al. 2002:1230). Alternatively, as this analysis only considers the proportions of deaths, the more likely explanation for this phenomenon is that it is simply a reflection of the decline of summer diarrheal disease from improved access to clean running water and sewage disposal, and thus an artificial "increase" in respiratory infections is observed.

Since pollution levels likely declined due to the halt of economic activity and industrial production during the depression (Chay and Greenstone 2003), the more likely explanation for an increase in death due to respiratory infections among infants is an unidentified outbreak of summer virus during the depression years in Hamilton. If the data were simply an artifact of the decline of summer diarrhea due to improved sanitary infrastructure, the same results would be expected for the fall. Since gastrointestinal infections remain the primary cause of death in the autumn, this explanation seems unlikely. Unfortunately since there is no way to test these hypotheses directly, further historical research is necessary to help explain the observed pattern.

"Bowel complaints" peaked as a cause of death in the late Victorian era at the end of summer / beginning of fall (Howe 1997:173) – a trend that can still be found in some contemporary societies today (Victora et al. 1985). The high incidence of diarrheal mortality and morbidity has been correlated with an increase in temperature during the summer months (Victora et al. 1985:29). The persistence of diarrhea as a cause of death in infants in Hamilton during summer-fall is most probably a result of early introduction of infants to contaminated foods found most commonly in environments where poor hygiene and lack of sanitary infrastructure prevail – among the poor (Bradshaw et al. 1997).

In the early nineteenth century, diarrheal diseases were seen as a result of "improper food, teething, over feeding, chill, and in the case of a child at the breast, by the mother being out of health from eating unsuitable food" (Members of Baby's Health Association 1928:no page). Although the health benefits associated with breastfeeding were noted early on within the medical community (MacMurchy 1910, 1911), the results of this study indicate that this was not a common practice among mothers in Hamilton. Indeed, of 899 reported cases of infectious diarrhea in Hamilton among infants in 1925, only 157 (17 percent) were breastfed (Hamilton Health Association 1925:22).

Comacchio (1993) explains that bottle-feeding among the working-class was more of a necessity than a choice due to mothers' employment outside the home. Among the middle and upper classes, however, it was the "modern" and more "popular" thing to do.

Additionally, recommendations and strict directions from physicians on preparing formula were widely distributed through educational literature. For example, the handbook "*Baby's Health and Record*" contains specific formula recipes and strict feeding schedules for infants as early as three days after birth. (The recipes were mixtures of milk and barley water) (Members of Baby's Health Association 1928). Physicians did not necessarily believe that bottle-feeding was responsible for intestinal infections, but that they were caused by "improper" bottle-feeding. Bottle-feeding was completely acceptable by physicians, as long as mothers followed instructions (Comacchio 1993:121-122). The baby book warns: "every mother should consult a physician before feeding her baby on other than her own breast milk" (Members of Baby's Health Association 1928: no page). Again, diarrheal diseases caused by administering formula was seen as a lack of adherence to medical instruction and was considered a result of ignorance on the part of the mother (Comacchio 1993:121-22).

Despite the underlying bias that existed in the medical approach to the social factors affecting infant health, this prejudice did not necessarily permeate all areas of the public health department in Hamilton. The work of the Babies' Dispensary Guild and other child welfare clinics was revered for their humanistic side. It was considered that the help provided by these associations "does not pauperize, because it requires the intelligent co-operation of the recipients and is given at such cost as they are able to pay" (The Hamilton Times, 31 January 1912). The extra care shown towards homeless mothers was particularly important, as the homeless are most likely to suffer the worst health outcomes (Wright 1991:71). The child welfare clinics, especially pre-natal, were mostly attended by "indigent" mothers[12]. Through the joint efforts of the public health department and the relief department, arrangements were made to hospitalize these expectant mothers during their pregnancy to provide the best pre-natal care possible under such circumstances (Hamilton Health Association 1928-29). Moreover, mothers were visited at home by public health nurses "within a few days after the birth being registered" regardless of their class. The number of these visits was impressive; 3,878 in 1928 and 3,901 in 1929 (Hamilton Health Association 1829-29:30). Not only did these visits give mothers the opportunities to ask for guidance, but also allowed the nurses to identify poor living conditions.

The significant decline in the infant deaths, particularly the reduction of the gap in the infant mortality rate between the rich and the poor in the face of the challenge presented by the Great Depression, speaks volumes to the success of the public health movement. The city health department glowingly reported each year the numbers of neonatal home visits made by nurses to mothers of all social classes (Hamilton Health Department 1925-35). Their hard dedicated work must be acknowledged, for it truly was a remarkable success. But how much was the improvement in infant health attributed to the work of the health department? Were any other factors involved in improving the survival of Hamilton's most vulnerable citizens?

Social Geography of Hamilton

The effect of population density on infant mortality in Hamilton yielded very

[12] those belonging to the underclass, the poorest of the poor (Murray 1994)

limited results. The northern wards had a higher population density than the southern wards both before and during the Great Depression. The average annual population density in the south declined over the years (from 4,627 people/km^2 pre-depression to 4,104 people/km^2 during the depression) while it increased in the northern wards (from 7,123 people/km^2 pre-depression to 7,956 people/km^2 during the depression). If population density had a direct effect on infant mortality, the observed rates should have decreased in the southern wards over the years, and increased in the north. An average decrease in the infant mortality rates was observed, however, in both the south *and* the north parts of Hamilton during the depression, showing that other intervening factors must have influenced infant mortality to a greater degree than density alone. Nevertheless, it must be noted that population density plays a significant role in disease transmission through increased interpersonal contact and overcrowding (Woods and Woodward 1984:169) and thus cannot be completely dismissed as an influential factor in human health.

The general explanation for the poor health status of illegitimate children is the prevalence of "social prejudices, and because illegitimate children usually lacked the care of their fathers, poverty and misery were the lot of the mother and child" (Kok et al. 1997:193). Single women were left to fend for themselves and their children in a society that not only ostracized their 'immoral' behaviour and situation, but where earning a living for women was much more difficult due to inequalities in wage labour.

In Hamilton, illegitimacy increased during the Great Depression among young mothers. When the homeless population was excluded from analysis, however, no difference was observed between the northern and southern wards. Whether these results reflect an increase in illegitimate births or an increase in infant deaths of children born outside of wedlock, this phenomenon could be explained through the effects of the declining economic conditions.

During the depression many young people put off starting families because it was economically not feasible at the time (Doucet and Weaver 1991:467). Therefore, if a young woman became pregnant, the likelihood of getting married in the 1930s was probably low. Moreover, many families were faced with poverty during the depression. Even in the best of times a young single mother without additional support from family may not be able to provide for her infant in the same way as a two-parent family. Therefore infant mortality in single-parent households, especially during the Great Depression, would likely have increased.

These explanations presented here are speculative at best. Unfortunately not enough information is available to conclusively determine the effects of legitimacy on infant mortality in this study. Because only information for legitimacy is available for infant deaths rather than births, only proportions of illegitimate deaths could be analyzed rather than infant mortality rates among illegitimate children. Since a strong association has been noted in other studies, I encourage further pursuit of this topic in future research.

The results of infant mortality by immigrant status can be interpreted in several ways. It is safe to say that there were unequal conditions acting in the northern and southern sections of Hamilton. Babies of immigrant mothers were less likely to survive in the north and infants of Canadian-born mothers were in some way sheltered in this part of the city. Although some cultural differences in neonatal and post-neonatal care between immigrant and Canadian mothers may be a plausible explanation, it is unlikely. The most probable explanation for the overrepresentation of immigrant (by family status) infant deaths in the northern wards of Hamilton is that it is a reflection of the social boundaries in the city; immigrants clustered in the northern wards while Canadians clustered in the southern wards. It is therefore indicative of the social geography of Hamilton where the northern wards were populated by the immigrant working-class, and the more affluent Canadian-born citizens of Hamilton populated the southern half of the city (Figure 5.1).

A different pattern emerges when the results are considered at the municipal level. The data indicate that, on average, more infants born to immigrant mothers than Canadian-born mothers died annually between 1925 and 1932. Between 1933 and 1935 this pattern reversed. Considering that there were more Canadian-born (23,619) than immigrant women (20,336) of childbearing age (age 15-49 years) (WHO 1999) in Hamilton in 1931 (Census of Canada 1931), this suggests that for the majority of the study period, immigrant families had lower health status than native-born Canadians in Hamilton. This issue, however, is much more complex. The census data indicates that crude fertility rates (Grabill and Cho 1965) were higher for immigrant (0.37) than Canadian (0.23) mothers (Census of Canada 1931), therefore the higher number of deaths may simply be a factor of the birth rates. As previously mentioned, however, the higher number of deaths cannot be simply considered to be an 'immigrant' problem because

> [t]he behaviour of the mass of scantily educated, unskilled, poor, southern European immigrants is not so very different from that of native-born wives who are equally under-privileged. The contrast lies in the fact that there are very few

> native-born wives who are similarly underprivileged, and for that reason immigrant behaviour patterns appear to be very distinctive. (Ware 1975:376)

The relationship between socio-economic status and infant health in Hamilton during the study period is not clear-cut. Although socio-economic status (by ethnicity) did influence where people settled, it was not necessarily a direct cause of infant mortality. Nevertheless, the results support other historical data regarding the social geography and socioeconomic composition of Hamilton's wards (Gagan 1981; Doucet and Weaver 1991).

Housing and Living Conditions

Doucet and Weaver (1991) express that in Hamilton, "if not precisely classes, the [occupational] groups connote stratification" (324). Their work focused on housing and living conditions in Hamilton during the twentieth century. The rise of the sanitary reform to eradicate the sources of infectious diseases was a response to the cholera epidemic that occurred in Hamilton in 1854 (Gagan 1981; Campbell 1966:116). The construction of sanitary infrastructure, more specifically water reservoirs, sewers and water mains, were encouraged by Dr. James Roberts, the M.H.O. of Hamilton in 1905 and continued well into the twentieth century (Bailey 1983; Doucet and Weaver 1991). By the 1920s the sewer and water lines were constructed in most of the neighbourhoods in Hamilton (Doucet and Weaver 1991:442) (Figures 5.2 and 5.3).

Although Doucet and Weaver (1991) report that construction of water mains took precedence over the sewer system (442), the data presented in Figures 5.2 and 5.3

Figure 5.1 Armenian Children, North Hamilton, 1928-29.

Source: McMaster University, Labour Studies Collection

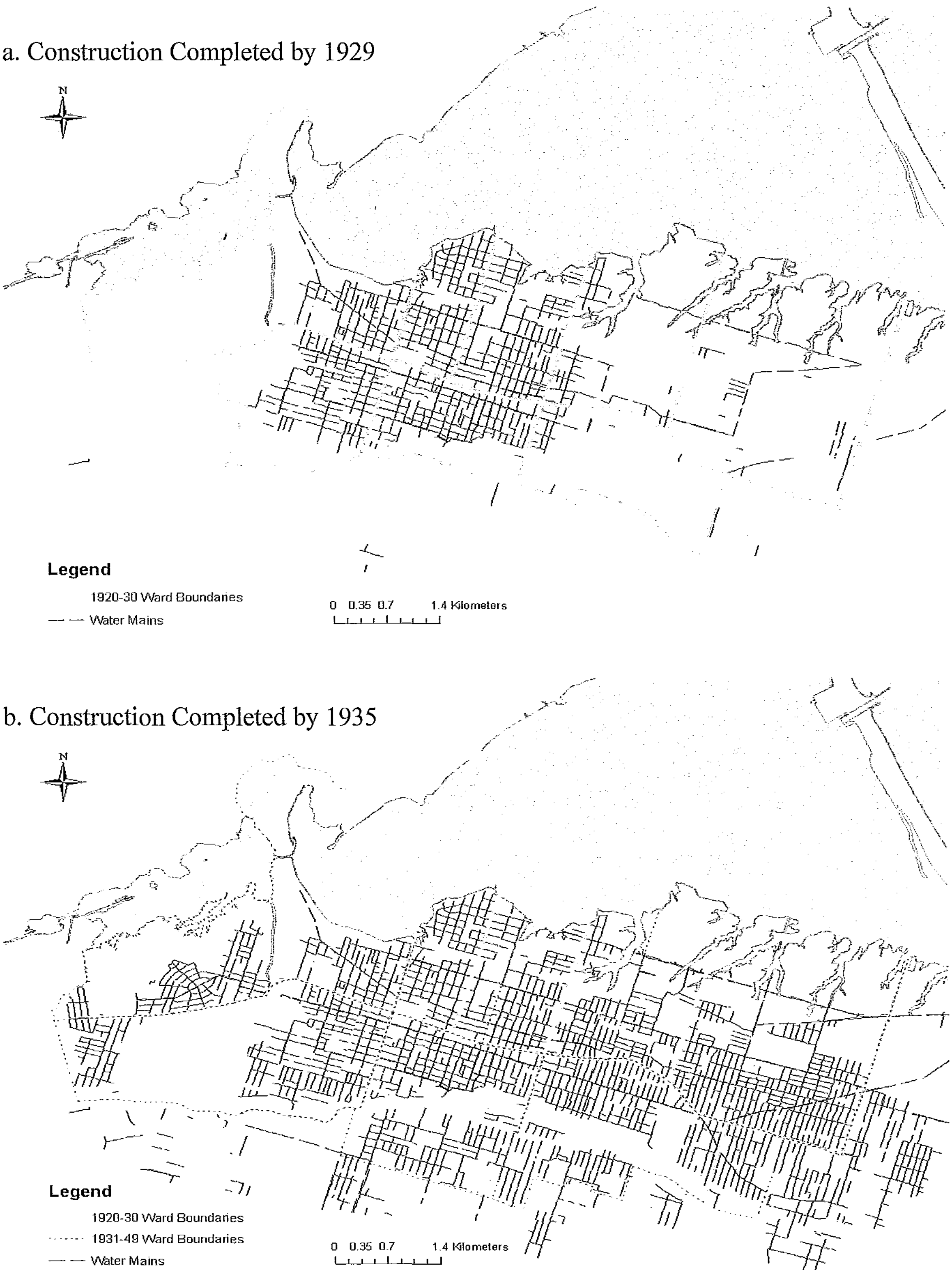
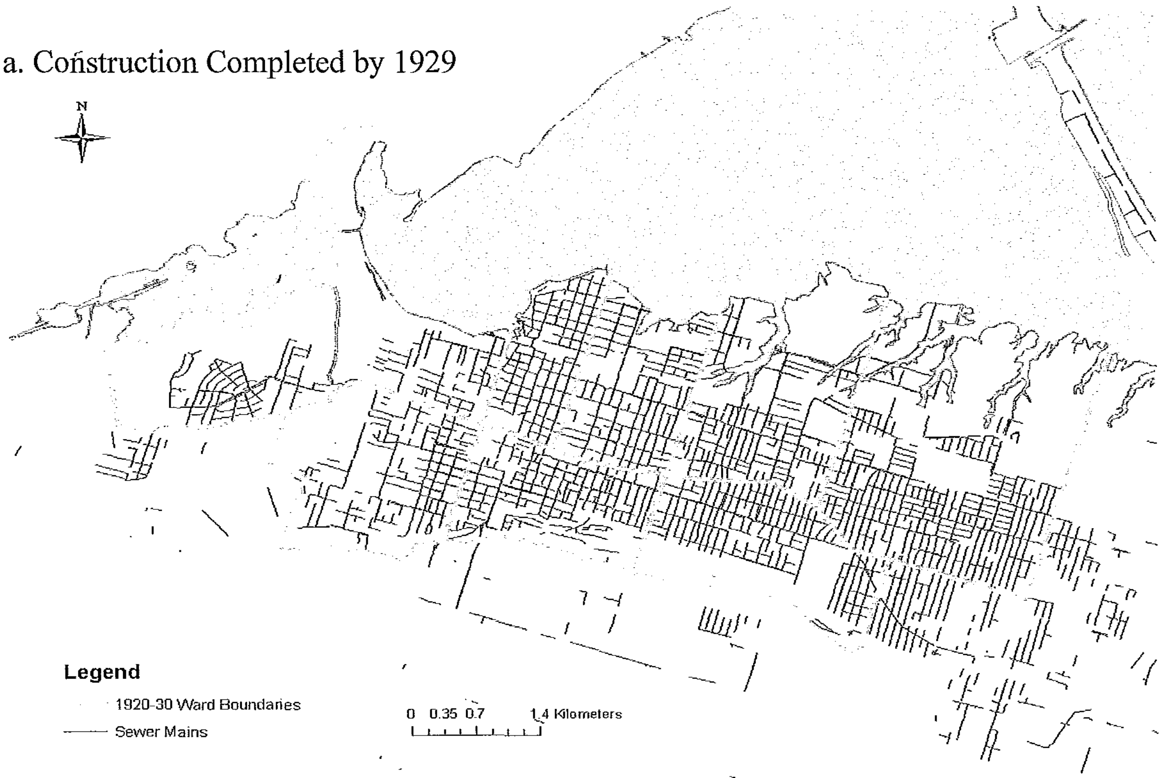


Figure 5.2 Water Main Construction, City of Hamilton.

Source: City of Hamilton 2008b

a. Construction Completed by 1929



b. Construction Completed by 1935

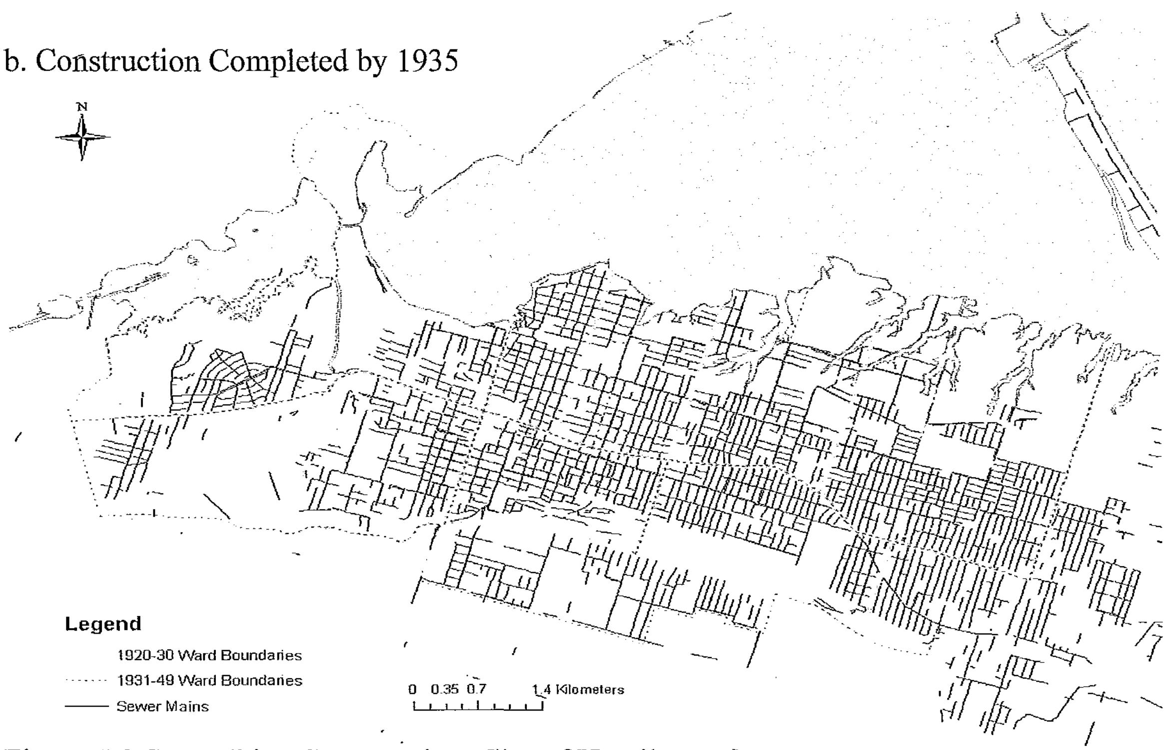


Figure 5.3 Sewer Line Construction, City of Hamilton.
Source: City of Hamilton 2008b

contradict this. In 1929 water main construction was almost complete in the western wards (wards 2-6) but was mostly lacking in the east (wards 1, 7-8). By 1935, however, the construction of water mains was completed in the eastern wards. In contrast to water mains, by 1929 sewer lines were installed across the entire city and between 1930 and 1935 continued construction was necessary only in the newly annexed areas (southernmost parts of wards 1 and 2).

Access to clean water and adequate sewer disposal are considered the most important factors in reducing IMRs. Although by 1929 water mains were constructed in wards 5 and 6 before wards 1, 7 and 8, the IMRs in wards 5 and 6 were considerably higher in comparison to the eastern wards. This observation is explained by the lack of installation of these services within homes. The construction of infrastructure along city streets does not guarantee access to these services at the household level. Doucet and Weaver note a lag in the installation of these necessities by slum landlords. Furthermore, over the study period the appearance of many names in the Hamilton Board of Health minutes requiring in-home installation confirmed that hundreds of households still did not have access to running water and / or sewer connections (Hamilton Board of Health 1925-35).

Household access to sanitary infrastructure was not equal within occupational or socio-economic class; rather it was more closely associated with location. Harris and Mercier (2005) contend that during the interwar years some suburbs, or "fringe areas" were as unsanitary as the worst inner city slums due to lack of access to sanitary infrastructure resulting in higher infant mortality rates. This contrasts with the conditions in Hamilton. The housing boom of the 1920s in Hamilton resulted in an "overbuilding of apartments and houses" (Doucet and Weaver 1991:400). Due to the high demand and corporate competition between housing companies, the new lots that were being developed in the east (ward 8) and west (western half of ward 4) parts of the city already included installation of water and sewer mains to make them more attractive to buyers. For example, Doucet and Weaver (1991) note that as early as 1921 "77.6 per cent of the suburban lots [were developed] with water and 75.2 per cent of the properties with sewers" (107). Therefore while the working-class population inhabiting the east end of Hamilton benefited from urban development, those living in wards 5, 6 and 7 did not; these wards were part of "the old city where…smaller dwellings were more concentrated" and did not benefit from the deed restrictions introduced in 1906 protecting the quality of newly built houses (Doucet and Weaver 1991:465).

The availability and conditions of housing changed further during the depression; the living environment improved for some while for others it deteriorated further. Some common labourers "seemed to have shared somewhat in the better housing stock arising from the 1920s construction boom…[where the] improvement in the stock of houses meant generally better accommodations for Hamilton households during the great depression" (Doucet and Weaver 1991:434). The phenomenon of the housing boom, combined with a declining population and lower occupancy during the 1930s in the city resulted in an oversupply of good quality houses available to them at bargain rental prices (Doucet and Weaver 1991:434). These, however, were only available to families who were still employed. The unemployed further plummeted into slum condition housing.

The low occupancy level in 1934 in Hamilton was a result of poorer families that "doubled up" in overcrowded dwellings. The evidence from Doucet and Weaver's (1991) study indicates "that perhaps a third of the units in Hamilton's potentially poorest housing form might have been overcrowded" (459). Most of these families were unemployed common labourers. Although the city had actively worked to reduce poor living conditions by conducting sanitary inspections throughout the year (Hamilton Health Association 1925-35), slum neighbourhoods were identified in wards 5 and 6 in a housing survey conducted by the city in 1936.

The municipal government did not readily acknowledge the existence of poor housing conditions in the city. In a newspaper interview, Mayor Wilton claimed : "We have no slum conditions…We are leaving that matter entirely to the health department" (The Hamilton Herald, 20 March 1935). While some officials insisted that the government should fund work to improve living and housing conditions in Hamilton (The Hamilton Herald, 17 April 1935), the Mayor completely denied the existence of a problem. The lack of responsibility for the conditions and ultimately health of the poorest members of society at the political level was appalling. The Hamilton poor were thus left to survive with little acknowledgment and whatever help the health department could provide.

The "North End"

Of all the wards located in the northern section of Hamilton, ward 5 had the worst health outcomes for the study period as indicated by the infant mortality rates. Unlike the other neighbourhoods, the IMRs in this ward increased for the depression period, even when the homeless population was excluded from analysis. Why did infant health further decline in this ward while it improved everywhere else in the city? Why were the efforts of the Babies' Dispensary Guild and the Public Health Department not enough?

The reasons for this situation are numerous and interconnected but fall into two main categories. First are the material components that have been discussed in this chapter, such as the deteriorating housing conditions, the lack of access to clean water, and the proximity to industrial pollution. Second are the social components associated with increased psychological stress, such as stigma and social isolation. Both are equally important to consider as factors that impact health. Some researchers contend that people living in economically disadvantaged neighbourhoods generally suffer from poorer health resulting in higher mortality rates (Ross and Mirowsky 2001; Anderson et al. 1997). Moreover, socially rooted psychological effects of living in poor neighbourhoods, such as feelings of distrust and shame, may further contribute to poor health outcomes (Jama 2004). These arguments are based on the concept that the perception of ones' living environment directly affects the quality of life and health.

Another theory has been proposed to explain why, for example, public health initiatives may not be successfully implemented. People's attitudes and behaviours are shaped based on their structural contexts (Ross 2000). Living in a disadvantaged neighbourhood is associated with a negative perception on many levels. If a person believes that his/her opportunities are limited, he/she is more likely to engage in risky behaviour or, for the sake of this argument, may be less likely to engage in healthy behaviour, such as exercising or attending clinics aimed at preventive health measures. Furthermore, the contagion effect may influence people's behaviours. If it is socially acceptable in a neighbourhood to act a certain way, for example not to attend a clinic, people are more likely to follow this norm. Neighbourhoods tend to form their own set of cultural norms within which people function, and engaging in behaviour that breaks this norm may further ostracize individuals.

Although impossible to say for certain, the evidence suggests that the labourers, and certainly the homeless who resided in the public institutions and streets located in the northern wards, who were exposed to this negatively perceived living environment, suffered even more than people of the same social status living in other areas in Hamilton for the study period. The poor housing, lack of access to sanitary infrastructure, industrial pollution, isolation and social stigma, and a general disinterest by the municipal government in improving living conditions all played a part in constructing the deplorable environment of ward 5. It is therefore not surprising that infant health further deteriorated in this neighbourhood during the Great Depression. Sadly not much has changed over the last century. These neighbourhoods are still some of the most economically disadvantaged parts of Hamilton and the people living there suffer the highest rates of mortality and morbidity (Jama 2004; Pouliou 2005).

Conclusions

Earlier in this chapter I presented three hypotheses used in the past as explanatory models for the changes seen in infant mortality. Having reviewed the results of this study and the social conditions of Hamilton between 1925 and 1935, I conclude that to some extent a combination of all these ideas may help explain the observed trends in infant mortality. The increased infant mortality rates for the middle-class Hamiltonians during the Great Depression almost equal to levels seen among the working-class indicates that it was not only the poor that were vulnerable to the effects of economic decline. In fact, the observation that a proportionately greater increase in infant mortality was seen among the more affluent population compared to the less well-off might indicate that they were likely affected even more because they struggled to adjust to their new economic conditions. Additionally, cultural differences are suspected to contribute to this as breastfeeding was less common among the more affluent families thereby increasing the risk of infant death.

Although McKeown's (1976) explanation of better health due to improved nutritional status is inconclusive in this study due to insufficient data, the effects of living conditions may be more salient. Considering the local historic context, living conditions are closely related to environmental differences based on geographic location within the city. The conditions created by the housing boom of the 1920s, combined with the increased availability of housing at the expense of the severely impoverished unemployed labourers, granted some of the working-class citizens access to better housing with superior utilities in the form of clean water and sewage disposal.

It was impossible, however, to assess housing conditions for one group in Hamilton – the "indigents". The problem of homelessness was not new to the city. In 1925, approximately 400 homeless individuals took up "residence" at the local hospitals after being admitted for health related problems (The Hamilton Spectator, 3 March 1926). The evidence of a significant homeless population in Hamilton indicates the need to study health conditions among this impoverished group. The lack of a permanent home address excluded the majority of this group from this study and only a small sample was captured here thereby limiting the extent to which analysis was possible. It is therefore highly recommended that this topic be further pursued in the future with a comparison of the health conditions of individuals without a listed home address to those who had permanent residences.

The gap between the middle- and working-class infant mortality rates diminished throughout the study period; however the average rates for the years remained significantly different. Though slight fluctuations in infant mortality existed in the early 1930s in Hamilton, the forces resulting from the efforts of the public health department to actively reduce infant mortality in the city outweighed the adverse economic effects of the Great Depression. Unfortunately the success seen through declining infant mortality did not translate to improvements in maternal health. The detrimental effects of the depression were expressed through an increased neonatal mortality rate in the last years of the study period.

The direct causes responsible for post-neonatal mortality were analyzed in this study and were determined to be of infectious nature, which McKeown (1976) attributes to a poor sanitary environment. The underlying factors responsible for the persistence of such circumstances are important to consider. Social and political forces acted on many different levels and were ultimately responsible for the conditions that predisposed the immigrant population to poor living environments, impacting every aspect of their lives. The degree of choice they could make about their health was limited by their socio-economic condition, which, on a large scale, was influenced by the decisions of the governing body at the global, national and municipal level. Occupation and employment, housing, ecological and physical environment, and healthcare are all interrelated and determined by macro-level events, which are never shaped by those who would benefit most from improvements to them. Rather, such decisions are made against the best interest of the lowest social classes to benefit the elite.

The results presented in this thesis cannot by any means be considered conclusive and absolute. The limited nature of the data available can at best yield estimates of true infant mortality rates because birth data for the study period are not available. Access to birth certificates would allow for the detailed examination of infant mortality rates by ethnicity, occupation and religious affiliation. Moreover, the study would not be constrained by arbitrary neighbourhood divisions and would thus eliminate the error associated with aggregate level analysis.

This research demonstrates how a complex history and local conditions play a significant role in not only shaping a society but also in the factors that collectively affect the health status of a population. A comparative study of infant health in other urban centres across Canada could further illuminate how the effects of the economy influence people's health. This type of comparative analysis could uncover the experience of not only other cities but more specifically other immigrant groups in Canada, giving them a voice in Canadian history.

As suggested by stillbirth and neonatal mortality, a study of maternal health conditions during this time period is crucial to truly understand infant health. This type of research would be more informative if conducted at the individual rather than community level because one's health status is based on the cumulative life history beginning at birth. This would not only contribute to the scientific discourse on maternal factors responsible for a baby's health but would further the understanding of the mechanism though which economic conditions affect fetal development.

In summary, this thesis contributes to the local history of Hamilton, Ontario. Population health is explored through the effects of economic conditions of the Great Depression on the patterns and trends of infant mortality. It is intended to help better understand the political economy of infant health in the early twentieth century.

APPENDIX I

Table 1. Distribution of Neonatal Infant Deaths by Ward, City of Hamilton 1925-1935.

	Ward								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
1925	9	6	9	8	13	16	10	21	**92**
1926	5	3	13	5	14	16	19	24	**99**
1927	5	6	6	5	10	16	17	26	**91**
1928	7	5	11	13	2	8	15	20	**81**
1929	6	4	12	4	9	16	15	23	**89**
1930	1	5	9	7	16	8	12	24	**82**
1931	5	2	12	3	13	10	18	20	**83**
1932	7	7	7	7	18	15	9	16	**86**
1933	6	7	9	7	15	7	4	15	**70**
1934	5	9	6	4	20	16	6	20	**86**
1935	7	7	9	4	20	10	15	11	**83**

Table 2. Distribution of Post-Neonatal Infant Deaths by Ward, City of Hamilton 1925-1935.

	Ward								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
1925	6	7	8	10	22	18	12	28	**111**
1926	1	2	9	6	22	14	18	15	**87**
1927	2	3	10	7	15	8	11	16	**72**
1928	2	1	7	6	13	13	14	22	**78**
1929	2	10	10	10	20	14	7	25	**98**
1930	2	7	8	6	14	8	8	22	**75**
1931	0	3	9	8	12	9	9	19	**69**
1932	8	8	8	5	20	11	20	9	**89**
1933	1	4	13	10	13	12	15	8	**76**
1934	3	6	3	5	11	10	4	13	**55**
1935	2	3	6	4	10	9	3	3	**40**

APPENDIX I continued

Table 3. Distribution of Total Infant Deaths by Ward, City of Hamilton 1925-1935.

	Ward								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
1925	15	13	17	18	35	34	22	49	**203**
1926	6	5	22	11	36	30	37	39	**186**
1927	7	9	16	12	25	24	28	42	**163**
1928	9	6	18	19	15	21	29	42	**159**
1929	8	14	22	14	29	30	22	48	**187**
1930	3	12	17	13	30	16	20	46	**157**
1931	5	5	21	11	25	19	27	39	**152**
1932	15	15	15	12	38	26	29	25	**175**
1933	7	11	22	17	28	19	19	23	**146**
1934	8	15	9	9	31	26	10	33	**141**
1935	9	10	15	8	30	19	18	14	**123**

APPENDIX II

Table 1. Infant Mortality by Inclusion of Homeless for Pre-Depression in Ward 3, City of Hamilton 1925-29.

Homeless	Died	Survived	Total
Included	95	1,156	**1,251**
Not Included	70	1,181	**1,251**
Total	**165**	**2,337**	**2,502**

Note: $X^2 = 4.06, p = 0.0440$, df = 1, OR = 1.39 (95% CL: 1.00 < OR < 1.93)

Table 2. Infant Mortality by Ward and Death Cohort, City of Hamilton 1925-35.

A. PRE-DEPRESSION (1925-29)[1]			
	North (wards 5-8)	**South (wards 1-4)**	**Total**
Died	637	261	**898**
Survived	6,156	4,230	**10,386**
Total	**6,793**	**4,491**	**11,284**

B. DEPRESSION (1930-35)[2]			
	North (wards 5-8)	**South (wards 1-4)**	**Total**
Died	610	284	**894**
Survived	7,488	5,349	**12,837**
Total	**8,098**	**5,633**	**13,731**

[1] Note: $X^2 = 46.93, p = 0.0000$, df = 1, OR = 1.68 (95% CL: 1.44 < OR < 1.95)
[2] Note: $X^2 = 33.87, p = 0.0000$, df = 1, OR = 1.53 (95% CL: 1.32 < OR < 1.78)

Table 3. Infant Mortality by Legitimacy for Death Cohort, City of Hamilton 1925-35.

A. EXCLUDING HOMELESS INFANT DEATHS[1]			
	Pre-Depression (1925-29)	**Depression (1930-35)**	**Total**
Legitimate	818	832	**1,650**
Illegitimate	34	60	**94**
Total	**852**	**892**	**1,744**

B. INCLUDING HOMELESS INFANT DEATHS[2]			
	Pre-Depression (1925-29)	**Depression (1930-35)**	**Total**
Legitimate	834	832	**1,666**
Illegitimate	62	60	**122**
Total	**896**	**892**	**1,788**

[1] Note: $X^2 = 6.40, p = 0.0114$, df = 1, OR = 1.74 (95% CL: 1.10 < OR < 2.73)
[2] Note: $X^2 = 0.03, p = 0.8713$, df = 1, OR = 0.97 (95% CL: 0.66 < OR < 1.42)

APPENDIX II continued

Table 4. Infant Mortality by Mother's Country of Birth and Wards, City of Hamilton 1925-35.

	North	South	Total
Immigrant	732	203	**935**
Non-Immigrant	498	332	**830**
Total	**1,230**	**535**	**1,765**

Note: $X^2 = 69.62, p = 0.0000$, df = 1, OR = 2.40 (95% CL: 1.94 < OR < 2.98)

Table 5. Infant Mortality by Mother's Country of Birth and Death Cohort, City of Hamilton 1925-35.

	Pre-Depression (1925-29)	Depression (1930-35)	Total
Immigrant	499	436	**935**
Non-Immigrant	386	444	**830**
Total	**885**	**880**	**1,765**

Note: $X^2 = 8.28, p = 0.0040$, df = 1, OR = 1.32 (95% CL: 1.09 < OR < 1.59)

Table 6. Infant Mortality by Cause of Death* and Death Cohort, City of Hamilton 1925-35.

	Pre-Depression (1925-29)	Depression (1930-35)	Total
Infectious	414	396	**810**
Non-Infectious	445	446	**891**
Total	**859**	**842**	**1,701**

Note: $X^2 = 0.23, p = 0.6306$, df = 1, OR = 1.05 (95% CL: 0.86 < OR < 1.27)
* Does not include deaths due to unknown and non-specific causes (n = 125).

APPENDIX II continued

Table 7. Infant Mortality for Cause of Death by Wards and Death Cohort, City of Hamilton 1925-35.

A. INFECTIOUS CAUSES[1]	Pre-Depression (1925-29)	Depression (1930-35)	Total
North (wards 5-8)	300	284	**584**
South (wards 1-4)	114	112	**226**
Total	**414**	**396**	**810**

B. CONGENITAL CAUSES[2]	Pre-Depression (1925-29)	Depression (1930-35)	Total
North (wards 5-8)	242	243	**485**
South (wards 1-4)	117	126	**243**
Total	**359**	**369**	**728**

[1] Note: $X^2 = 0.06$, $p = 0.8128$, df = 1, OR = 1.04 (95% CL: 0.75 < OR < 1.43)
[2] Note: $X^2 = 0.20$, $p = 0.6563$, df = 1, OR = 1.07 (95% CL: 0.78 < OR < 1.48)

Table 8. Infant Mortality due to Airborne Infections for Wards, City of Hamilton 1925-35.

A. PRE-DEPRESSION (1925-29)[1]	North (wards 5-8)	South (wards 1-4)	Total
Died of Airb. Infec.	152	56	**208**
Didn't Die of Airb. Infec.*	6,641	4,435	**11,076**
Total	**6,793**	**4,491**	**11,284**

B. DEPRESSION (1930-35)[2]	North (wards 5-8)	South (wards 1-4)	Total
Died of Airb. Infec.	158	54	**212**
Didn't Die of Airb. Infec.*	7,940	5,579	**13,519**
Total	**8,098**	**5,633**	**13,731**

[1] Note: $X^2 = 14.66$, $p = 0.0001$, df = 1, OR = 1.81 (95% CL: 1.32 < OR < 2.50)
[2] Note: $X^2 = 21.53$, $p = 0.0000$, df = 1, OR = 2.06 (95% CL: 1.49 < OR < 2.84)
* Because this tests for differences in the cause-specific infant mortality rate, this category includes deaths due to all other causes. It is the difference between the total number of live births and the number of cause-specific deaths.

APPENDIX II continued

Table 9. Infant Mortality due to Airborne Infections for Death Cohorts, City of Hamilton 1925-35.

A. NORTH[1]	Pre-Depression	Depression	Total
Died of Airb. Infec.	152	158	**310**
Didn't Die of Airb. Infec.	6,641	7,940	**14,581**
Total	**6,793**	**8,098**	**14,891**

B. SOUTH[2]	Pre-Depression	Depression	Total
Died of Airb. Infec.	56	54	**110**
Didn't Die of Airb. Infec.	4,435	5,579	**10,014**
Total	**4,491**	**5,633**	**10,124**

[1] Note: $X^2 = 1.49, p = 0.2226$, df = 1, OR = 1.15 (95% CL: 0.91 < OR < 1.45)
[2] Note: $X^2 = 1.93, p = 0.1645$, df = 1, OR = 1.30 (95% CL: 0.88 < OR < 1.93)

Table 10. Infant Mortality due to Food / Waterborne Infections for Wards, City of Hamilton 1925-35.

A. PRE-DEPRESSION (1925-29)[1]	North (wards 5-8)	South (wards 1-4)	Total
Died of Food/Wat. Infec.	152	56	**208**
Didn't Die of Food/Wat. Infec.*	6,641	4,435	**11,076**
Total	**6,793**	**4,491**	**11,284**

B. DEPRESSION (1930-35)[2]	North (wards 5-8)	South (wards 1-4)	Total
Died of Food/Wat. Infec.	152	56	**208**
Didn't Die of Food/Wat. Infec.*	6,641	4,435	**11,076**
Total	**6,793**	**4,491**	**11,284**

[1] Note: $X^2 = 34.34, p = 0.0000$, df = 1, OR = 2.77 (95% CL: 1.92 < OR < 4.01)
[2] Note: $X^2 = 20.32, p = 0.0000$, df = 1, OR = 2.37 (95% CL: 1.58 < OR < 3.55)
* Includes deaths due to other causes.

APPENDIX II continued

Table 11. Infant Mortality due to Food / Waterborne Infections for Death Cohorts, City of Hamilton 1925-35.

A. NORTH[1]	Pre-Depression	Depression	Total
Died of Food/Wat. Infec.	152	56	**208**
Didn't Die of Food/Wat. Infec.	6,641	4,435	**11,076**
Total	**6,793**	**4,491**	**11,284**

B. SOUTH[2]	Pre-Depression	Depression	Total
Died of Food/Wat. Infec.	152	56	**208**
Didn't Die of Food/Wat. Infec.	6,641	4,435	**11,076**
Total	**6,793**	**4,491**	**11,284**

[1] Note: $X^2 = 10.56$, $p = 0.0012$, df = 1, OR = 1.59 (95% CL: 1.19 < OR < 2.12)
[2] Note: $X^2 = 1.82$, $p = 0.1769$, df = 1, OR = 1.36 (95% CL: 0.85 < OR < 2.16)

Table 12. Infant Mortality by Season, City of Hamilton, 1925-35.

A. PRE-DEPRESSION (1925-29)[1]	Winter	Spring	Summer	Fall	Total
Died	232	252	186	213	**883**
Survived	3,277	3,628	3,785	3,178	**13,868**
Total	**3,509**	**3,880**	**3,971**	**3,391**	**14,751**

B. DEPRESSION (1930-35)[2]	Winter	Spring	Summer	Fall	Total
Died	199	254	178	260	**891**
Survived	4,212	4,519	4,530	4,030	**17,291**
Total	**4,411**	**4,773**	**4,708**	**4,290**	**18,182**

[1] Note: $X^2 = 16.71$, $p = 0.0008$, df = 3
[2] Note: $X^2 = 28.30$, $p = 0.0000$, df = 3

APPENDIX II continued

Table 13. Seasonal Infant Mortality by Death Cohort, City of Hamilton 1925-35.

A. WINTER[1]	Died	Survived	Total
Pre-Depression (1925-29)	232	3,277	**3,509**
Depression (1930-35)	199	4,212	**4,411**
Total	**431**	**7,489**	**7,920**

B. SPRING[2]	Died	Survived	Total
Pre-Depression (1925-29)	252	3,628	**3,880**
Depression (1930-35)	254	4,773	**5,027**
Total	**506**	**8,401**	**8,907**

C. SUMMER[3]	Died	Survived	Total
Pre-Depression (1925-29)	186	3,785	**3,971**
Depression (1930-35)	178	4,530	**4,708**
Total	**364**	**8,315**	**8,679**

D. FALL[4]	Died	Survived	Total
Pre-Depression (1925-29)	213	3,178	**3,409**
Depression (1930-35)	260	4,030	**4,290**
Total	**473**	**7,208**	**7,699**

[1] Note: $X^2 = 16.75, p = 0.0000$, df = 1
[2] Note: $X^2 = 8.50, p = 0.0036$, df = 1
[3] Note: $X^2 = 4.37, p = 0.0365$, df = 1
[4] Note: $X^2 = 0.16, p = 0.6895$, df = 1

APPENDIX II continued

Table 14. Differences in Proportion of Seasonal Infant Deaths by Death Cohort, City of Hamilton 1925-35.

A. WINTER[1]	Died in Season	Didn't Die in Season	Total
Pre-Depression (1925-29)	232	651	**883**
Depression (1930-35)	199	692	**891**
Total	**431**	**1,343**	**1,774**

B. SPRING[2]	Died in Season	Didn't Die in Season	Total
Pre-Depression (1925-29)	252	631	**883**
Depression (1930-35)	254	637	**891**
Total	**506**	**1,268**	**1,774**

C. SUMMER[3]	Died in Season	Didn't Die in Season	Total
Pre-Depression (1925-29)	186	697	**883**
Depression (1930-35)	178	713	**891**
Total	**364**	**1,410**	**1,774**

D. FALL[4]	Died in Season	Didn't Die in Season	Total
Pre-Depression (1925-29)	213	670	**883**
Depression (1930-35)	260	631	**891**
Total	**473**	**1,301**	**1,774**

[1] Note: $X^2 = 3.74$, $p = 0.0530$, df = 1
[2] Note: $X^2 = 2.52$, $p = 0.1121$, df = 1
[3] Note: $X^2 = 0.32$, $p = 0.5708$, df = 1
[4] Note: $X^2 = 5.80$, $p = 0.0160$, df = 1

Table 15. Differences in Seasonal Infant Mortality for Fall by Death Cohort, City of Hamilton 1925-35 (Excluding Entries for October 1933).

	Died	Survived	Total
Pre-Depression (1925-29)	213	3,178	**3,409**
Depression (1930-35)	220	3,850	**4,070**
Total	**433**	**7,028**	**7,479**

Note: $X^2 = 2.60$, $p = 0.1071$, df = 1

APPENDIX II continued

Table 16. Differences in Proportion of Seasonal Infant Deaths for Fall by Death Cohort, City of Hamilton 1925-35 (Excluding Entries for October 1933).

	Died in Season	Didn't Die in Season	Total
Pre-Depression (1925-29)	213	670	**883**
Depression (1930-35)	202	649	**851**
Total	**415**	**1,319**	**7,479**

Note: $X^2 = 0.04$, $p = 0.8508$, df = 1

APPENDIX III

Cause of Death for Infants, City of Hamilton, 1925-35.

Cause of Death	n of infant deaths
INFECTIOUS:	**810**
Airborne	
bilateral broncho pneumonia	2
bronchitis / capillary bronchitis	10
broncho pneumonia / bronchial pneumonia	274
chickenpox	1
(double) lobar pneumonia	26
hypostatic pneumonia	2
influenza	8
influenza (flu) pneumonia	5
intestinal influenza	1
laryngismus stridulus	1
measles	3
nasopharyngitis	2
pleuro pneumonia	2
pneumonia	61
pneumonia meningitis	1
septic pneumonia	2
tubercular meningitis / tuberculosis	9
upper respiratory tract infection	1
whooping cough / pertussis	8
infection of lungs	1
Total:	**420**
Food and Waterborne	
auto intoxication from bowel	2
cholera infantum[1]	2
diarrhea	13
dysentery	10
enteritis / gastro enteritis	25
enterocolitis[2] / colitis / gastro colitis / ileo-colitis	9
fermentative diarrhoea / toxic diarrhoea	11
gastritis / gastrointestinal upset	2
indigestion / intestinal indigestion	14
infectious diarrhoea	18
intestinal intoxication / intestinal infection / intestinal toxaemia	174
stomatitis	1
Total:	**281**

[1] Age at death 159 and 163 days – not considered congenital
[2] Enterocolitis in infants is here considered as an infection following Kliegman (1979)

APPENDIX III continued

Cause of Death	n of infant deaths
INFECTIOUS (cont'd):	
Other	
(general) toxaemia	5
acute infection	1
brain abscess	2
cellulitis	1
cerebro spinal meningitis / cerebral meningitis	6
empyema	2
encephalitis	6
epiphysitis	1
erysipelas	11
infection jaundice	1
infection of meninges	1
mastoiditis	1
meningeal irritation	1
meningitis	20
meningocele (infected)	1
myocarditis	2
nephritis	1
otitis media	3
pachymeningitis	1
pericarditis	1
peritonitis	8
pneumoccous meningitis	3
pneumonic meningitis	2
pyaemia	3
pyelitis	6
pyleonephritis	1
septicaemia	13
streptococcal infection of heart	1
streptococcal meningitis	2
thrush	1
unknown general infection	1
Total:	**109**

APPENDIX III continued

Cause of Death	n of infant deaths
NON-INFECTIOUS:	**891**
Congenital	
(neonatal) cardiac failure / cardiac insufficiency	7
anacephalic monster	5
asphyxia neonatorum / congenital asphyxia	9
atelectasis neonatorum	4
birth injury	17
blue baby	7
breach presentation	1
cerebral haemorrhage - birth injury	39
congenital / foetal atelectasis	7
congenital debility	17
congenital deformity / defect	25
congenital heart	30
congenital problems of intestine / bowel	9
congenital syphilis / lues	11
difficult birth	12
eclampsia	3
haemophilia	2
hemorrhage of the new born	24
icterus neonatorum (gravis) / jaundice (congenital)	9
inhalation / respiration of meconium	2
lack of vitality	2
maternal factors	4
meningocele	4
mongoloid	2
monstrosity	2
patent foramen ovale	2
pemphigus	2
premature	425
prolapse cord	2
pyloric stenosis	2
spina bifida and/or hydrocephalus[3] (neonatal)	38
toxaemia - birth related	1
transverse presentation	1
uterine toxaemia	1
Total:	**728**

[3] Hydrocephalus is only considered congenital when listed in association with spina bifida thus indicating its congenital etiology. Otherwise it is grouped as "non-infectious other" because it is more often an acquired condition rather than congenital (Laurence 1960).

APPENDIX III continued

Cause of Death	n of infant deaths
NON-INFECTIOUS (cont'd):	
Other	
accidents	7
acrodynia	2
aneurism	2
atelectasis	14
burns	1
cancers	3
cardiac failure	16
cerebral injury	1
congenstion of lungs	1
dilatation of heart	1
dilatation of stomach	1
exposure to weather	1
gastric catarrh	1
hydrocephalus	4
intussusception / obstruction of bowel	17
jaundice	3
malnutrition	51
marasmus	27
nutritional oedema	1
pulmonary oedema	1
pyelonephrosis	1
raptured falx cerebri	1
respiratory failure	2
rupture of the liver	1
suffocation / asphyxia	3
ulcerative bolitis	1
Total:	**164**

APPENDIX III continued

Cause of Death	n of infant deaths
UNKNOWN / NON-SPECIFIC:	**125**
asphyxia (unknown)	5
condentis	1
convulsions	11
failure of circulation	1
found dead	2
general debility	1
haemorrhage	43
inanition	27
infantile paralysis	1
no cause of death listed	2
pylorospasm	1
status thymico lymphaticus / thymus[4]	16
sudden death	5
unclear	4
unknown	5
Total:	**125**

[4] "Status (thymico) lymphaticus", and other causes of death attributed to enlarged thymus gland, were popularly assigned as cause of mortality among infants in the nineteenth and early twentieth centuries despite the rejection of this by Dr. Friedleben in 1858 (Poets 1996:165). It was only officially rejected in the medical community as a legitimate cause of death in 1931.

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