LUND UNIVERSITY
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The Urban Penalty

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Abstract: The stimulus for this essay was given by the fact that life expectancy in certain countries started to increase long before the development of modern medicine. Having as a principal axis the so called 'urban penalty', the analysis was limited in two port cities; Glasgow and Malmö. Data on crude, age-specific and disease-specific mortality were used over the period 1800-1914 in order to identify the mortality development of these two cities. In addition, data on various investments were used for the two cities mentioned above. All these combined, tried to answer a principal question concerning whether the reduction in mortality before the advancement of modern medicine was associated with investments. If the answer to this question was positive, two secondary questions were raised concerning firstly, which investment proved to be more effective, and secondly, if there was an investment that could be described as a 'common ingredient of success'. The analysis of these two cities revealed that undoubtedly their mortality decline over the second half of the 19th century was driven by investments; however, it did not manage to reveal any 'winner' in terms of efficiency, or any common 'ingredient of success'.

Key words: Urban mortality, investments, mortality decline

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Chapter 1: Introduction

1.1 Research problem, aim and scope

Nowadays, longevity is taken pretty much for granted; however, the extension of the life span is a very recent accomplishment compared to the lengthy human history. In fact, two centuries ago, and for all the human history before that, longevity was a scarcity. Death rates were very high and they were mainly concentrated in younger ages (Weeks, 2008). Communicable diseases were a commonplace and children were less likely to survive until adulthood. But, even if they did, their chances of dying at an old age were extremely limited (Weeks, 2008). These high death rates in an early age had implications in the life expectancy, keeping it at very low levels even during the 20th century.

Data for life expectancy before 1750 is very poor and as Wilmoth (2000, p. 1113) mentions, "around that time, the first national population data began being collected in Sweden and Finland.". Therefore, for the period before 1750 only assumptions can be made. In particular, it has been argued that during the Roman Era the estimated life expectancy at birth was 22 years, growing to a little more than 30 years during the Middle Ages. By the early 19th century, on the other hand, life expectancy in Europe and the United States was around 40 years (Weeks, 2008). The above show that there was an improvement in life expectancy; however, it was a very slow one. It took people the time period from the Roman Era and until the 19th century to gain roughly 20 more years of expected life at the time of their birth.

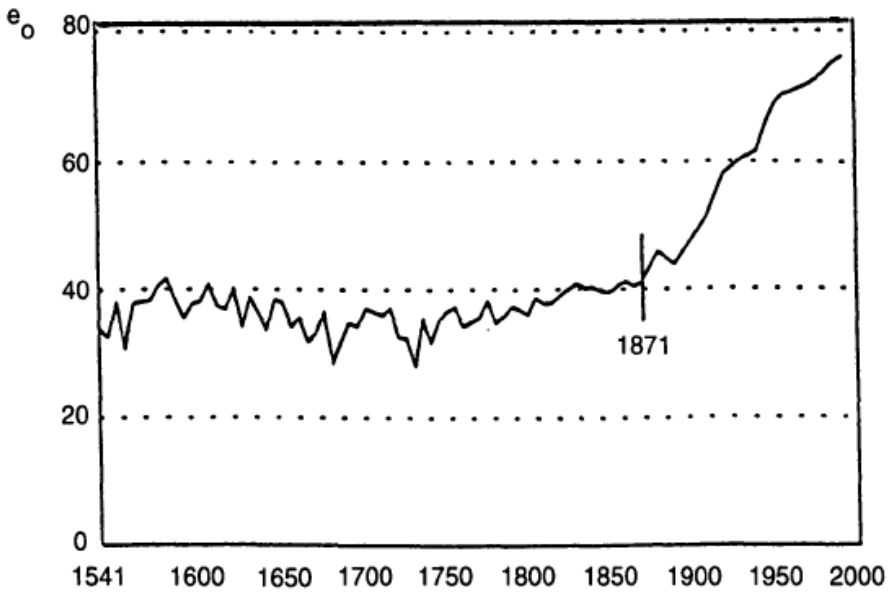
By the mid-19th century, the estimated life expectancy started to increase, while, during the 20th century, country after country in the developed world experienced an 'explosion' in terms of life expectancy (Weeks, 2008). This improvement in the life span is the rapidest the human history has ever experienced. A proper example would be that of England. A male born in 1851 was expected to live for 40 years, while, a female was expected to live for 44 years. In the beginning of the 21st century, however, these numbers had grown to 76 and 81 years respectively (Weeks, 2008). Something similar happened in Sweden. A woman born in 1840 was expected to live approximately for 45 years, while in the beginning of the 21st century her life expectancy at birth had grown to approximately 82 years. In fact, according to Oeppen and Vaupel (2002) since 1840, females have gained three additional months of life every year. Although slightly smaller, the corresponding results about the development of the male life expectancy range at the same frequencies.

The explanations for this astonishing increase are numerous and will be better discussed in the next section. Briefly, the protagonists among them are the improved nutrition and living standards brought by modern economic growth, the 'sanitation revolution', the development of the germ theory of disease, and the improvement of modern medicine with the use of antibiotics for the cure of disease.

Figures 1 and 2, show the development in life expectancy in England and Wales, and Sweden over the periods 1541-2000 and 1750-2011 respectively. Looking at those two figures, it is possible to identify the rapid increase in life expectancy, especially over the course of the 20th century. The turning point of

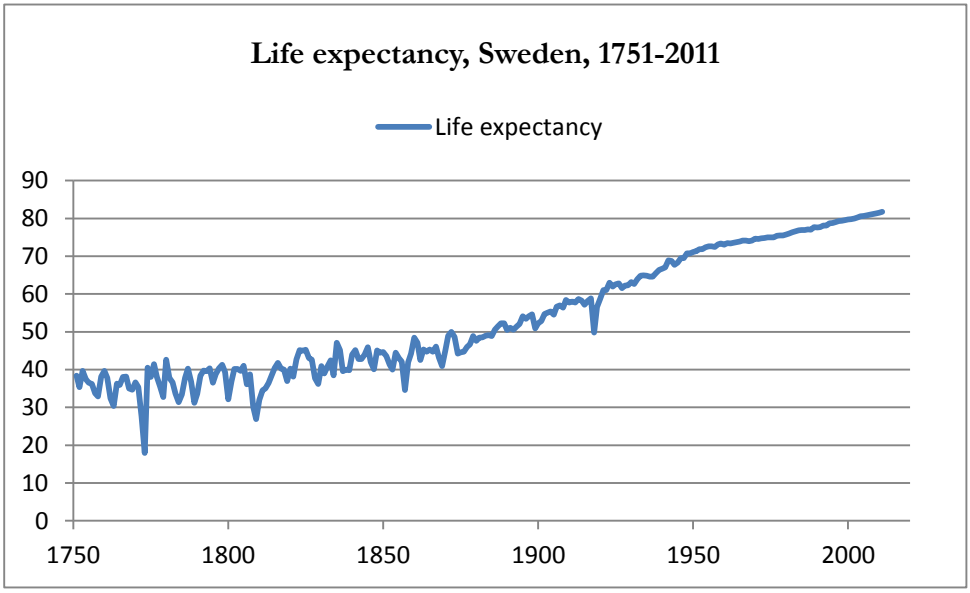
this astonishing increase was in 1871 for England and Wales (Easterlin, 1999), and in 1840 for Sweden (The Human Mortality Database, 2013).

Figure 1. Life expectancy in England and Wales, 1541-2000.



Source: *Figure 2.* R. A. Easterlin, 1999, p. 262.

Figure 2. Life expectancy in Sweden, 1751-2011.

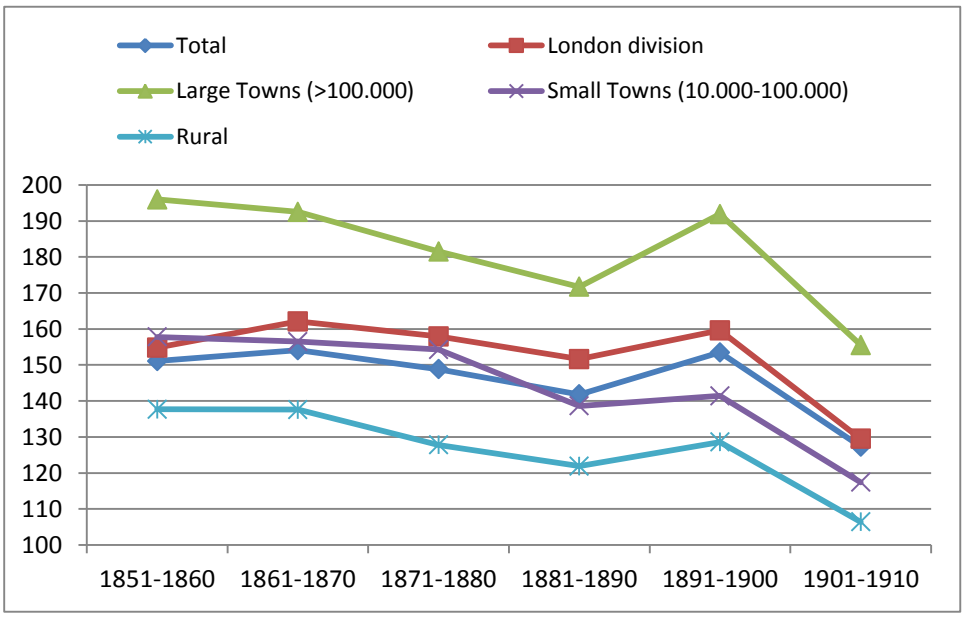


Source: The Human Mortality Database, 2013.

The benefits of modern medicine in the extension of the life span are unquestionable. However, the problem that arises from the observation of figures 1 and 2 is that the increase in life expectancy in those two countries started long before the advancement of modern medicine, which occurred in the late 1930s.

By limiting the phenomenon in the city level, it has to be mentioned that throughout the 19th century, urban areas presented higher mortality rates than rural areas (Easterlin, 1999; Easterlin, 1995), and this can be easily seen in figures 3 and 4 concerning infant mortality in England and Wales, and Sweden.

Figure 3. Infant Mortality Rates for different areas in England and Wales, 1851-1910.



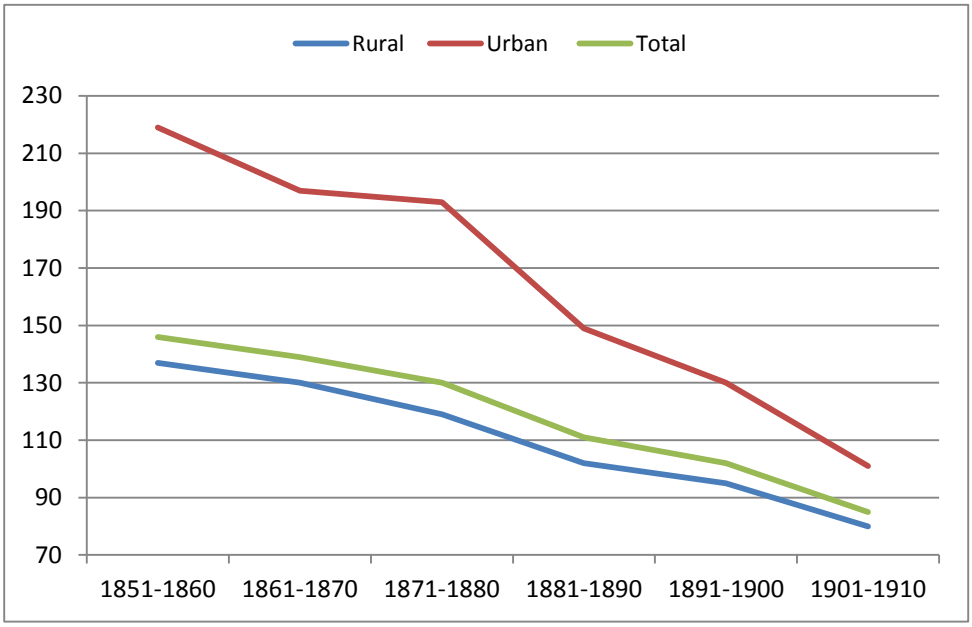
Note: Manchester and Newcastle were selected to represent the large towns with a population of more than 100.000 inhabitants, while, Bath, Cambridge, and Exeter were selected to represent small towns with a population between 10.000 and 100.000 inhabitants

Source: Based on *Table 2*. N. Williams and C. Galley, 1995, p. 411

In the case of Glasgow and Malmö the results were similar. Both cities presented higher mortality rates than the countryside and their mortality decline occurred almost at the same time and long before the advancement of modern medicine. More specifically, Glasgow marked a decrease in terms of mortality after 1871, while Malmö, showed the same trend in mortality after the period 1875- 1880.

The purpose of this paper will be to isolate these two cities and investigate them over the period 1800-1914, namely, the period in which modern medicine did not exist. The study will try to shed light on the relationship between mortality decline and investments; including, among others, housing, sanitation and vaccination, and will try to answer the following questions: Was the increase in life expectancy, before the development of modern medicine, connected to investments?; If yes, which investments proved to be more effective?; And, Is it possible to find a similar pattern linking investments and life expectancy between those two cities, hence, was there a common 'ingredient of success', or, the fact that these two cities showed signs of reduced mortality around the same time period is completely random?.

Figure 4. Infant Mortality Rates for Urban and Rural areas, Sweden 1851-1910.



Source: Based on: *Tab. 41.* In Serien Historisk Statistik för Sverige. SCB, 1969, p. 115.

1.2 Previous Research

The reasons behind the decline in mortality, and the subsequent increase in life expectancy, have always been a subject of discussion among the scientific community. The literature of previous research covers a wide range of views, the most important of which, will be discussed in this section.

Maybe the most known, and the most discussed, explanation for the mortality decline in the nineteenth century is the one about the positive effects of modern economic growth. More specifically, Mc Keown and his associates (1972) mentioned that since 1838, the rise in living standards, and the subsequent improved nutrition were the key factors behind the reduction of mortality rates associated with tuberculosis. In fact, they argued that the explanation of improved diet is the strongest one, as, over that period, modern medicine did not exist and there is no proof that there was a reduction in the virulence of the specific disease.

However, even though the positive effects of improved nutrition are unquestionable, Easterlin (1999; 1995) argued that the modern economic growth had a dual role in life expectancy. On the one hand, it was responsible for an increase in living standards (higher income per capita), which led to a higher resistance in disease, and thus a rise in life expectancy; while, on the other hand, it provoked a mass concentration of the population in the urban centers, increasing, thus, the exposure to disease, and leading to a lower life expectancy.

In fact, Easterlin (1999; 1995) used the example of the rural areas to support his argument that, until the time when a systematic effort was made to prevent disease, the positive effects of economic growth were counterbalanced by the negative effects of urbanization. More specifically, he mentioned that even

though the rural areas had admittedly lower incomes per capita than the urban areas, they enjoyed a higher life expectancy at birth (circa 10 years more).

Another known explanation is that of a spontaneous reduction in mortality. This means that at a certain point of time, there was a change in the relationship between the agent of disease and the human host.

This phenomenon, according to the science of virology, is very likely to happen. Viruses, like any other parasitic microorganisms, can survive only by infecting another organism, the host. Thus, in terms of evolution, the aim of the infectious carrier is to manage to infect the host easily, multiply itself inside it, and spread by infecting other organisms. From this perspective, it is not advantageous for the infectious agent to kill its host, at least quickly, because if it does, it will not be able to infect other organisms.

However, even though this explanation can be true for at least a part of the mortality decline from some specific diseases, researchers are particularly reluctant concerning its contribution to the rapid mortality decline before the era of systematic vaccination (Mc Keown et al., 1972).

Easterlin (1999), criticized Mc Keown's view, which related the improved nutrition to the observed mortality decline, and cited his own explanations for this phenomenon. More specifically, he argued that the key to the decreased mortality after the second half of the 19th century lies in three major innovations.

The first major breakthrough was a range of activities aiming at the prevention of the transmission of disease. This movement, whose activities included a severe effort for the clearance of the urban centers, and campaigns for the education of the public concerning personal hygiene, is known as the 'sanitation' revolution (Easterlin, 1999, p. 270).

The 'sanitation' revolution has its roots in the 1840's England. Influenced by the miasmatic theory, which linked disease to bad smells, the urban authorities tried to eliminate bad smells by cleaning up the cities. The way to accomplish that was through a better water supply and sewerage disposal, the paving of streets and the campaigns about personal hygiene. These measures, as Easterlin (1999) implies, were the driving force behind the reduction in the transmission of waterborne and airborne diseases. Finally, the discoveries of Snow in 1854 and Budd in 1859 relating contaminated water to the transmission of Cholera and Typhoid fever reinforced the efforts of the 'sanitation' revolution supporters (Easterlin, 1999; Mc Keown et al., 1972).

The second explanation for the improvement in life expectancy lies in the germ theory of disease and the vaccines that it introduced by the end of the 19th century. Inspired by the inventions of Pasteur and Kock this theory managed to identify the causal agents for a significant amount of diseases. This fact, enabled researchers to create vaccines and antitoxins which led to a further reduction in mortality (Easterlin, 1999; Mc Keown et al., 1972).

The two explanations mentioned above contributed largely to the reduction of mortality over the nineteenth century. However, by the discussion until now, it should be possible for the reader to see that both the 'sanitation' revolution, and the introduction of vaccines, and antitoxins; were measures aiming to

reduce mortality through the prevention of disease. In fact, as Easterlin (1999) mentions, the ability to cure disease was mainly absent until the introduction of antimicrobials in the late 1930s. Doctors and urban authorities could provide the measures to avoid disease, but, there was little they could do to help those who were truly sick (Easterlin, 1999; Mc Keown et al., 1972).

And this brings us to the last major explanation for the vast increase in life expectancy in the 20th century, namely, the development of modern medicine for the cure of disease. Starting in 1935 with the discovery of Sulfanomides by Domagk, and, continuing with the most important discovery of the 20th century in the field of medicine, that of Penicillin in 1941 by Fleming, the ability to control infectious diseases changed radically, leading to an increase in life expectancy (Easterlin, 1999).

Chapter 2: The Study

2.1 Data

It could be argued that mortality and life expectancy are in fact two sides of the same coin. In this study data on life expectancy and mortality will be used for Glasgow and Malmö over the period 1800-1914.

More specifically, in terms of mortality the Crude Death Rate will give the reader the general trend in mortality over the period under consideration. However, the Crude Death Rate cannot be regarded as an optimum indicator. And this is because it only takes into account the total number of deaths (Hinde, 1998). However, the deaths in general are not equally distributed among the different age groups. For this reason, age-specific mortality rates and infant mortality rates will be used in order to provide the reader with a better picture of mortality over the period 1800-1914. Such data, will also help to identify the differences in mortality of specific age groups over time, and, if possible, relate them with several investments.

Data regarding the population of Glasgow and Malmö will also be used, not only for the discussion of their population growth, but also, because they will help the reader to identify the relationship, if any, between mortality and population growth.

Finally, even though there is a risk that they may not be fully reliable (Fridlizius, 2002), data on disease-specific mortality will be used in order to identify the major causes of death during the 19th century. The study of disease-specific mortality rates, however, will also serve in identifying the most important investments of this period.

2.2 Outline

As already mentioned, this study will focus on the urban mortality throughout the 19th century. It will discuss its development in two port cities, Glasgow and Malmö, and will try to identify if the mortality decline, before the development of modern medicine was connected to investments. Then, and if the answer to the previous question is positive, it will try to identify which investments proved to be more effective. Finally, it will try to find if there was a similar pattern linking investments and the increase in life expectancy in those two cities.

The story will start with a general picture of the 19th century urban society. More specifically, Chapter 3 will discuss some characteristics of the 19th century city, such as, its social classes, the role of in-migration, its housing options and the various investments which took place during the period under consideration. Finally, it will provide the reader with a picture of the health conditions prevailing in the urban societies and will discuss how they were affected by the specific characteristics mentioned earlier. After the presentation of this general framework of the city, Chapters 4 and 5 will focus on the port cities of Glasgow and Malmö over the period 1800-1914. These chapters will begin with a brief description of the development of the specific cities from the period of their establishment and until the dawn of the 19th century. Subsequently, they will focus on the period 1800-1914, and discuss their population and economic growth, their mortality development and the investments which took place during that period. Moreover, Chapter 6 will discuss the mortality transition of Glasgow and Malmö, and will try to identify to what extent mortality was affected by investments. Finally, Chapter 7 will conclude and will discuss in what extent this study managed to answer the posed research questions.

Chapter 3: The Background

3.1 The 19th century city and its social classes

As Pinol (2000) plainly mentions, the 19th century city was characterized by social mobility. There were continuous transitions towards different social classes, and these transitions could either be upward or downward. This social mobility had a significant impact on the shaping of the urban areas, and, one could say that it was the reason behind the social segregation that followed, with the appearance of distinct microcosms existing simultaneously in the same city (Pinol, 2000).

Three social classes can be identified in the 19th century city, and all of them had a different point of view concerning family, housing and social life.

First, there is the upper-class or elite. It contained the aristocracy and the successful industrialists, bankers and entrepreneurs. The main characteristic of this class was its wealth. The upper-class accounted for a small percentage of the population; however, its economic power was enormous, and continued to grow throughout the 19th century (Pinol, 2000).

In terms of housing, and their general lifestyle, the upper-classes were possessed by a need to demonstrate their wealth. They had luxury houses; sometimes they purchased even three different houses during one generation, servants and they were mainly engaged in charities and other social events (Pinol, 2000). The men of the upper-classes attended social clubs which grew in importance throughout the 19th century, while, the role of women was restricted in parenting, managing the house and organizing social events (Pinol, 2000). Finally, as the 19th century progressed, there was a tendency for the upper-classes of all countries to abandon the overcrowded and unhealthy city center and relocate themselves in the city suburbs (Pinol, 2000).

The second social class is the middle-class. This class mainly contained all the non-manual occupations. Thus, in this class it was possible to encounter public and private employees, shopkeepers and in some cases artisans. The case of

artisans is singular, because they diversified themselves from the manual workers based on the independence they enjoyed in their employment. However, as Pinol (2000) mentions the boundaries of this class were particularly fragile and sometimes it was not easy to categorize someone in the middle-class based on his or her occupation.

The main characteristic of the middle-classes was their effort to imitate the lifestyle of the upper-classes. House and family were very important elements for this class, however, unlike the upper-class, this class was not interested in socializing. They also showed the tendency to abandon the city center, and they preferred to relocate themselves in detached houses with gardens and fences in order to preserve their privacy (Pinol, 2000).

Lastly, the third social class of the 19th century is the lower, or, working-class. This class mainly contained all the manual workers. One of the main characteristics of this class was its continuous movements onto and off the workplace (Pinol, 2000). This, of course, had implications in their housing preferences. The price of public transports, which made their appearance in the cities in the 19th century, was prohibitive for a worker's budget. This means that they preferred to live in the city center and be closer to their workplace than live in the suburbs (Pinol, 2000).

It has been argued that the major problem for a worker in the 19th century was the rent, and in fact, Pinol (2000) mentions that by the mid-nineteenth century, a working-class family in England had to spend approximately 10-15% of its budget on rent. As the nineteenth century progressed, these percentages increased even more, being especially high in big cities. In fact, in 1880, a worker who happened to live in London had to spend 20-30% of his budget just on his rent.

From the facts mentioned above, it can be easily understood that for the working class, housing and its comforts came at a second place. The more rooms a house held, the higher its rent was, so, workers preferred small houses lacking in basic comforts. In fact, in some cases, the cost of housing made the existence of subtenants a necessity. This practice was very common in the cities of the 19th century and it was very popular among in-migrants. In addition, the frequent change of residence was a very common phenomenon among people of the working-class. Their furniture and personal belongings were minimal in order to help them move-out fast, and in many cases, secretly if they could not afford to pay their rent (Pinol, 2000).

Finally, and as it will be seen later in this chapter, even though the overcrowding in small, unhealthy places had fatal results on the health of themselves, and their families; workers still preferred the proximity to their workplace rather than the healthier environment of a more distant location. In that decision, there was another factor, which played a very important role, that of the social interaction with other people. The smaller the house was the greater grew the need for the outer space. Workers literally spent most of their day outside in the street, the pubs and the parks. Therefore, living away from the city center would be a blow for their social interactions (Pinol, 2000).

To sum up, life in the 19th century cities was not the same for everyone. Each social class had a different point of view concerning housing, family and social

life. And, as it will be seen later in this chapter several studies have shown that in some cities not only life, but also death was not the same for everyone.

3.2 The role of in-migration

As Pinol (2000) mentions, the 19th century city was characterized by a continuous process of population movements. Cities could either lose population through the process of out-migration, or, they could gain population through the process of in-migration. Inside the city districts the phenomenon was quite similar (Pinol, 2000). No matter what the case, the result was a constant renewal of the city's population. This section will set aside those who abandoned the cities and focus on the in-migrants.

In-migration had been already apparent in the cities before the 19th century. However, this phenomenon was intensified during the nineteenth century, as there was a wide range of employment opportunities brought by the Industrial Revolution. Labor migrants could either be seasonal or permanent; they could either be skilled or unskilled; they could even originate from the immediate hinterland of a city, or, originate from abroad. Some of them had the same culture, language and religious beliefs as the native-born population, while some others had nothing in common with the inhabitants of the host city. Despite their distinctive features, the different groups of in-migrants had one thing in common, and that was the terror that they provoked to the native-born population (Pinol, 2000).

An in-migrant was often seen as a truant or a vagabond. It was seen as someone who would live in wretchedness, and, who would be constantly dependent on charity. To avoid this, many cities tried to pose restrictions in the influx of immigrants (Pinol, 2000). For instance, according to Pinol (2000, p. 207): "In New York, in the early 19th century, shipping companies carrying immigrants were required to pay a deposit for each new entrant, which was returned to them, only if the latter was not addressed, for one year after its advent, to a charity organization.". However, the insanity caused by in-migrants did not stop at the example mentioned above. In fact, some cities like Tours and Orleans located their railway stations at a great distance from their centers in order to avoid the unwelcome 'intruders' (Pinol, 2000).

However, labor force, and especially the cheap and unskilled one, was a necessary requirement for a city's development. And in-migrants could fulfill this need. Hence, despite the different restrictions posed by the urban authorities, in-migrants were a 'necessary evil' for the city (Pinol, 2000).

It has been argued that in-migration has been a decisive factor for the shaping of the urban areas (Pinol, 2000). And this is true in terms of many aspects.

One of the most important is that in-migration was closely related to population growth. In fact, for a very big part of the 19th century, its contribution in population growth surpassed that of natural increase. Therefore, it can be seen that at least for the first half of the 19th century (sometimes for even more), cities were highly dependent on in-migration for the continuation of their existence (Lee and Lawton, 2002).

Finally, as already mentioned, in-migration played an important role in the development of the 19th century city by fulfilling the need for cheap, unskilled labor. This phenomenon, however, had an impact on various demographic processes, namely mortality, fertility and nuptiality, and as it will be seen in section 3.5 it affected the general health of the city's population.

3.3 Housing in the 19th century city

As mentioned earlier, life in the cities of the 19th century was not the same for everyone. In fact, section 3.1 showed that each social class was a distinct microcosm with its own point of view in terms of family, housing and lifestyle. This section will take a closer look at the housing options in the 19th century cities.

The private mansion was eminently the housing option for the upper classes. Its premises, furniture and decoration were luxurious reflecting the wealth and social status of its owners, while, it had all the possible comforts of that Era (Pinol, 2000).

As far as the middle-class is concerned, the main housing options were the two- or three-floor detached houses, or smaller apartment buildings. These buildings were less luxurious than the houses of the upper-class. Their internal spaces were much smaller, they had fewer comforts and according to Pinol (2000) they were characterized by a semblance of luxury rather than luxury per se.

Finally, there was the need for the accommodation of the working class. A need that turned into a huge problem for the cities' authorities as the 19th century progressed (Pinol, 2000). There were four main housing options for the working class in the cities of the nineteenth century, namely, the back to back houses, the workers' tenements, the lodging houses, and, the shanties in the city's slums.

All of these houses were small, they were lacking in basic comforts and their hygiene was pathetic. For instance, ventilation was absent in many of these houses, and in many cases it remained absent until the end of the 19th century. In these unhealthy houses the majority of workers and immigrants stacked themselves and their families (Pinol, 2000).

3.4 Investments

Throughout the 19th century, several investments started to take place in the urban centers. These investments included among others the provision of fresh water and sewerage disposal, the city lightning and the development of public transportation, the introduction of vaccines and antitoxins, the appointment of medical officers etc. The list of investments throughout the 19th century is enormous and one could dedicate a whole book in order to discuss it properly. However, due to limitations on the extent of this paper only some of these investments will be discussed in this section. In order to facilitate their presentation, the several investments will be divided under three major categories, namely, those concerning the sanitation of the city, those concerning health, and those concerning the improvement of the city's houses.

Starting with the investments concerning the sanitation of the cities, one should definitely mention the investments for water supply and sewerage disposal.

The driving force behind these investments was the ever increasing need to combat the serious epidemics which were 'reaping' the urban populations. So, throughout the 19th century, urban authorities in various cities started to construct sewers and pipelines. However, for a big part of the 19th century water supply and sewerage disposal proved to be ineffective to a large extent. More specifically, in terms of water supply, even though the provision was improved, one could say that this was not the case for the quality of the water (Pinol, 2000). In terms of sewerage disposal, on the other hand, in many cities, sewers were constructed; however, they emptied their contents in the existing drinking sources. Finally, inequalities were persistent concerning water supply and sewerage disposal and in fact, in many cities the richer districts were served first, while, the poorer ones were served quite delayed.

In addition, the same need to improve health led many cities to undertake a series of actions, including among others the introduction of vaccination laws, the construction of hospitals, the campaigns promoting breastfeeding and personal hygiene, and the appointment of various health officers. Despite the fact that these actions began with the best intentions, the urban authorities often had to face various difficulties. In terms of vaccination and promotional campaigns the general public was not always willing to cooperate, while, many of these hospitals and public health officers could not be described as highly effective.

Finally, in terms of housing, urban authorities in many cities enacted laws concerning, among others the demolition of inappropriate residences, the erection of tenements for the working class and the control in the number of subtenants. These actions, however, were in general slow processes and their benefits were not always visible in the short run.

3.5 Health and the city

It would not be an exaggeration to say that until the 20th century, cities could be described by three words: death, disease and dirt. As already shown in figures 3 and 4, throughout the 19th century mortality rates in urban areas were higher than those in rural areas (Weeks, 2008; Pinol, 2000; Easterlin, 1999; Easterlin, 1995) and there is an abundance of explanations for this. Poor sanitation, absence of knowledge on the treatment of disease and the crowding of people into small places are only some of the causes for the high mortality levels over that period.

The cities of the 19th century were thus encumbered with regard to the health of their residents. Apart from the general sickly situation plainly described by Easterlin (1999), there were also some specific characteristics which complicated the situation.

From the discussion until now it has been shown that there were great socioeconomic inequalities in the 19th century city. In fact, even though it is not the case everywhere (Bengtsson and Van Poppel, 2011; Bengtsson and Dribe, 2011), several studies have shown the existence of mortality differentials

related to the socioeconomic status of the individuals. More specifically, Schumacher and Oris (2011), studying the life expectancy at birth for children in Geneva over the period 1625-2004 found significant differentials among social classes. In the same extent, Breschi et al. (2011, p. 374), concluded that in Alghero over the period 1866-1925, "… farmers and shepherds exhibit a significantly higher risk of death compared to the wealthiest SES groups.", while, in her study of Trieste, Marina Cattaruzza (2002), found that over the period 1878-1905 the city districts where the lower classes lived exhibited higher mortality rates than the districts of the middle- and upper-classes. Therefore, it can be easily seen that in some cities throughout the period under consideration, social class was a factor that could 'condemn' a person to a higher level of mortality, while in some other cities the same factor had no effect at all on mortality.

The discrepancies in mortality, however, did not only stop in social class. Several studies have shown mortality differentials among the in-migrants and the native-born population. In the same study of Trieste, Cattaruzza (2002), found that over the period 1878-1905 the city districts which exhibited highest death rates were in fact those where the majority of immigrants lived. In the same extent, Lee and Marschalck (2002) found that in Bremen in-migrants not only had a lower life expectancy than the native born population, but also, that there were significant differentials in disease-specific mortality among in-migrants and native-borns. The explanation for the excess mortality among immigrants stems from the fact that they fulfilled the need for cheap, unskilled labor. This means that they were mainly employed in financially insecure and physically hazardous positions (the docks, railway construction etc.). The hazardous nature of their job, made accidents one of the main causes of death among immigrants, rising thus, the overall Crude Death Rate. On the other hand, the financial insecurity of their employment had an impact on their housing and nutrition, leading to an increased incidence of disease. Hence, high levels of communicable diseases raised mortality rates with the majority of deaths being concentrated among infants and children (Lee and Lawton 2002, 13-14).

And this, leads the discussion to the impact of overcrowding and unhealthy housing on health. In terms of overcrowding, the main suspect was the modern economic growth. As already mentioned, new employment opportunities, brought by industrialization, attracted a vast number of people in the urban centers (Easterlin 1999, 266; Easterlin 1995, 397). Suddenly, urban authorities had to cope with an increasing number of new entrants who had to be housed. However, the 19th century showed that house building proved incapable to keep pace with the vast population increase, and the inevitable effect was severe overcrowding of the existing residences. Therefore, a large share of the population found itself living in small crowded places that failed to comply with even the most basic standards of hygiene. In fact, the association between living space and mortality is very strong and, for instance, Gibb (2002), showed in the case of Glasgow that mortality rates among infants and children were inversely proportional to the number of rooms existing in a house. Therefore, this crowding of people in unhealthy environments

combined with their contact with travellers carrying diseases kept the mortality levels high until the 20th century (Weeks, 2008; Easterlin, 1999).

Finally, as mentioned in the previous section, this sickly situation gave rise to several investments, some of which proved to be effective and some not (see for example, Ferrie and Troesken, 2005, about Chicago).

To sum up, this chapter tried to give a general idea of the 19th century city by discussing some of its features, namely, its morbidity, its inhabitants and its vast inequalities in life and housing among its different social classes. Of course, this does not mean that all the 19th century cities had exactly the same characteristics as those described in this chapter. However, the majority of them did. Consequently, bearing this picture of the city in mind, two cities of the 19th century, Glasgow and Malmö, will be discussed in chapters 4 and 5.

Chapter 4: Glasgow, 1800-1914

4.1 Glasgow through centuries

Glasgow is a city of West Central Scotland, situated on the banks of River Clyde. Even though the city's origins are unclear, it is known that its history dates back in the Middle Ages.

More specifically, during the 12th century the Scottish crown permitted the nobility and the church to have a burgh in Glasgow. Burghs were cities which enjoyed special privileges in terms of commerce and self-governance, in respect of certain revenues to the crown (McGrath, 2004a). Since the 12th century, Glasgow's power as a burgh started to increase, and in fact, by the end of the 15th century, the city had grown into a prevailing academic and clerical center (McGrath, 2004a).

It is believed that during the Mediaeval Period Glasgow's commercial activity was moderate, restricted to its inland and surrounding areas. Trade with Europe was much easier for the areas located in the East, while, the physical condition of the River Clyde, which was shallow in many places, was a substantial obstacle (McGrath, 2004a).

The 16th century, and especially the years after the Reformation of 1560s, marked the beginning of the city's trade. During this period, Glasgow was engaged in trade with its hinterland, Ireland, Argyll and the inner western isles. Trade with England and France also appeared during that period; however, foreign trade continued to be very limited (McGrath, 2004b).

The 17th century witnessed some events which favored Glasgow and contributed to its later development. The first event was the unification of the Scottish and English crowns in 1603. This union favored the city's linen trade and set the bases for the expansion of Glasgow's manufacture. The condition of the River Clyde remained an important obstacle even during the 17th century, and many attempts to remove its shallow parts failed to bear fruit (McGrath, 2004b). In addition, in 1668 the development of Port Glasgow started, and this port meant to play an important role in the city's future trade. Finally, during this period Glasgow's power as a burgh increased even more. In particular, by the mid-seventeenth century, Glasgow ranked fourth among the country's largest burghs, while in 1670 it was the second largest burgh behind only Edinburgh (McGrath, 2004b).

The 18th century proved to be even more remarkable for Glasgow. During this period, commercial activity turned to the Atlantic and Glasgow's location favored its trade with the New World colonies. After the Treaty of Union in 1707, Glasgow emerged as a key city for the tobacco trade. Indeed, large amounts of tobacco were shipped from Virginia to Glasgow, which then supplied the rest of Europe. By 1730, tobacco trade was at its peak, but, it was abruptly interrupted by the outbreak of the American Revolution (Cage, 1987a). This unfortunate event, however, did not discourage Glasgow's merchants who turned to West Indies importing another commodity, namely sugar; and made the city one of Britain's biggest sugar importers of the 18th century (Gibb, 2002). This century also meant the solution to the shallowness of Clyde. More specifically, in 1770 a series of piers was placed along the shores of the river, enabling the removal of the silt layers from Clyde's riverbed (Gibb, 2002). The 18th century, finally, meant the construction of canals, such as the Forth and Clyde and the Monkland Canal; which, together with the river, were the main routes for the transport of heavy materials from and to the city (Gibb, 2002).

4.2 The 19th century Glasgow

4.2.1 Industrialization and economic growth

Since the 18th century trade was an important feature in Glasgow's economic growth. The textile industry was also important, however, it was entirely domestic with textiles being mainly produced in the weaving villages around Glasgow (Moss, 2004). The outburst of the Industrial Revolution in the 19th century meant a radical development in the city's manufacture and heavy industry.

In the case of Glasgow, it is possible to identify two periods in terms of industrial growth. Over the first period, 1801-1841, Glasgow developed its textile industry, while, over the second, 1841-1914, it developed a very successful heavy industry (Gibb, 2002).

More specifically, the textile industry grew in importance during the 19th century driven by the innovations brought by the Industrial Revolution. By 1830, production was concentrated in factories inside the city and almost one third of the city's workforce was employed in this sector (Moss, 2004; Gibb, 2002). Cotton imports increased over this period and, according to Andrew Gibb (2002, p. 39) "… its processing and manufacture were to dominate the economy of the West of Scotland until the 1860s." As with tobacco, the American Civil War of 1861 and the competition from European and American cities, was a serious blow for the cotton industry in Glasgow (Gibb, 2002).

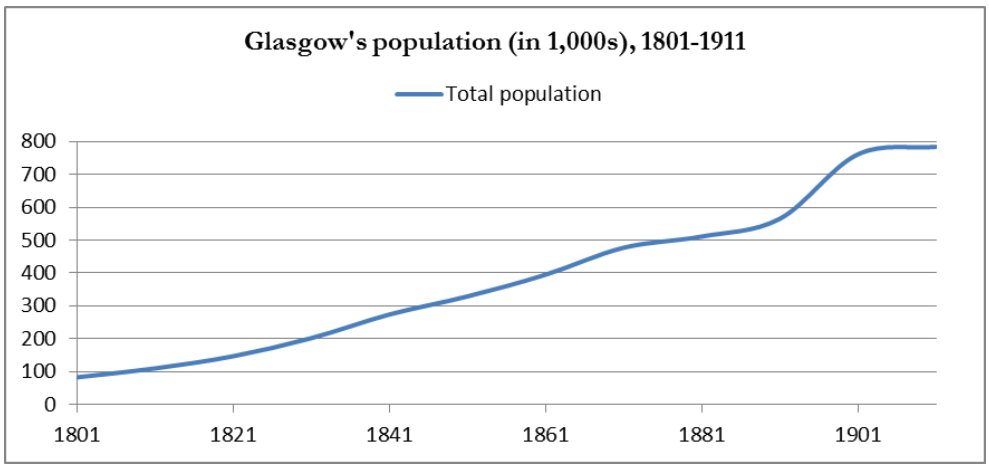
Like in the 18th century, however, the city's entrepreneurs found new economic opportunities in a variety of heavy industries, such as shipbuilding and locomotive construction (Fraser, 2004; Cage, 1987a; Cage, 1987c). More specifically, the shipbuilding industry began to develop when the steam power was applied to the boats navigating the Clyde in the 1820s, while, in terms of engineering, the expansion of the railway, first in Britain in the late 1840s and

then in the rest of the world set the cornerstones for Glasgow's locomotive construction and their distribution all over the world (Fraser, 2004).

4.2.2 Population growth, in-migration and housing

As already mentioned, in the case of Glasgow the 19th century can be divided into two periods in terms of economic growth (Gibb, 2002). The same is true in terms of population and immigration. The year 1801, is the first year for which detailed data on the city's population can be found (Cage, 1987a), and as it can be seen in figure 5, Glasgow's population grew from around 80.000 in the beginning of the 19th century to more than 780.000 inhabitants in the first decade of the 20th.

Figure 5. Glasgow's population, 1801-1911 (in 1,000s).



Source: Based on: *Table 2.3* A. Gibb, 2002, p. 41.

For the period, 1801-1841, in Glasgow, as in many other 19th century cities, in-migration was closely associated with population growth (Gibb, 2002). Over this period, immigrants originated mainly from three major regions, the city's rural hinterlands, thus the West Central Lowland Scotland, the Scottish Highlands, and Ireland (Gibb, 2002).

During the second period on the other hand, hence the period after 1841, migration remained important, however, population growth was mainly driven by natural increase. This means that during this period a higher amount of infants and children were surviving the existing infectious diseases (Gibb, 2002), however, this was not the only reason for the population growth. Since the mid-nineteenth century and until 1912, Glasgow's boundaries extended, adding great amounts of people in its population. Starting in 1846, the burghs of Anderston and Calton and the Barony of Gorbals were attached to the city, while the years 1891 and 1912 added 6.000 acres of territories to the city respectively (Gibb, 2002; Fraser, 2004).

As already mentioned, from the late 18th century, Glasgow's economic development had attracted immigrants of Irish, English and Scottish origin, while when the industrialization took off in the city; the immigrant flows were enriched by individuals of Italian and East European origin.

More specifically, the Irish element prevailed, and in fact, over the period 1846-1854, it was intensified as a result of the Irish Potato Famine (Pinol, 2000; Lee and Lawton, 2002). In addition, the increased trade opportunities in the city and the ever increasing industrial jobs, attracted skilled English migrants over the period 1851-1911. This demand for industrial skills was also the driving force behind the Russian and Polish in-migration, while lastly, a migrant group of Italian origin, occupied mainly in the service sector, was attracted to the city at the close of the century (Gibb, 2002).

In terms of housing, the inner-city parishes of Glasgow had always been an attraction for the immigrant groups leading to a severe housing shortage as early as in 1819. As the city's population continued to grow, house construction and population growth were not able to coincide and the inevitable result was an extremely serious overcrowding of the existing houses (Gibb, 2002; Cage, 1987c; Butt, 1987).

What has to be mentioned is that the discrepancies between the working class and the middle- and upper-classes in terms of housing prevailed. During the first phase of population growth, house building was mainly addressed to the middle-classes of Glasgow, who abandoned the polluted and overcrowded city center and settled in the surrounding areas (Gibb, 2002; Cage, 1987b).

As for the working class, it was left with three housing options. Small apartments which failed to comply with even the most basic standards of hygiene, tiny rooms in once big mansions of the middle-class, and, as Gibb (2002) mentions: "rat-infested lodging houses" (Gibb, 2002, p. 45; Butt, 1987).

Finally, during the second half of the nineteenth century, Glasgow was characterized by population redistributions between its core and its periphery (Gibb, 2002). More specifically, the demolition of the city's central slums, by the activities of the City Improvement Trust, and the change in the use of land, namely the construction of public buildings and offices in the city core, displaced residents. In the city's periphery, new tenements were erected, and they attracted large numbers of in-migrants, usually Italians and Scotts (Gibb, 2002; Cage, 1987a). However, not all immigrant groups showed the same preference for the newly erected tenements and this was particularly the case for the Irish element of the migrant population, for which the cheap houses in the city core remained a principal housing option (Gibb, 2002; Lee and Lawton, 2002).

4.2.3 Health

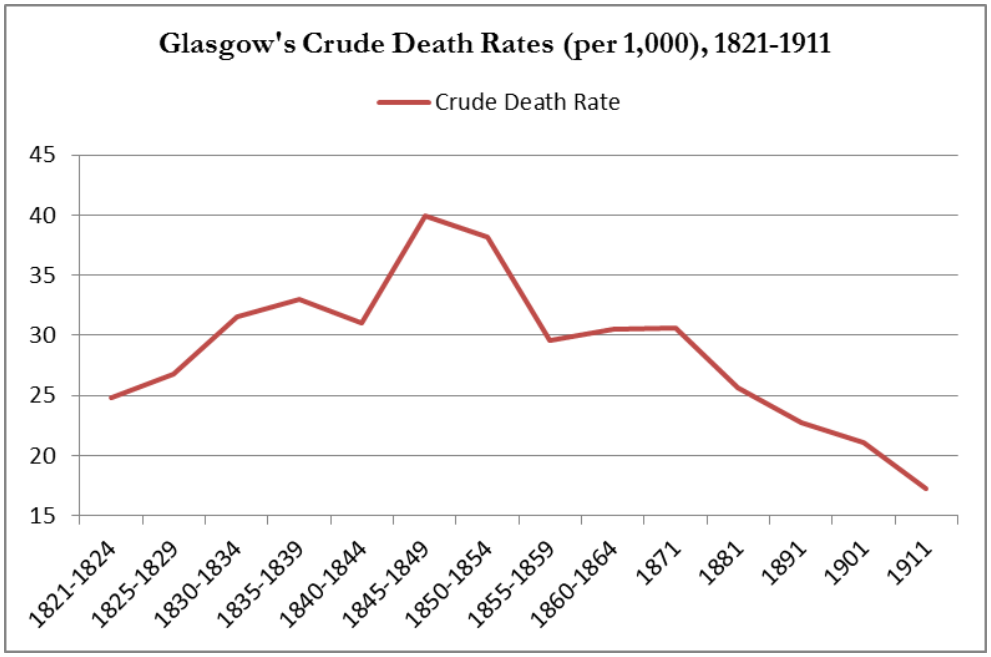
As mentioned in the previous sub-sections, massive immigration, low-quality housing and overcrowding were persistent in the 19th century Glasgow. These elements were by themselves more than enough to make the city vulnerable to epidemics (Fraser, 2004). An increase in the grain prices, in combination with a trade and industrial stagnation by the 1830s left thousands of people unemployed, and chronic hunger appeared to worsen even more the already bad situation (Gibb, 2002).

These conditions were responsible for a high level of disease with intense outbursts of epidemics. Communicable diseases did not discriminate between rich and poor. They appeared in the poorer districts and then 'attacked' the

richer ones as well. In addition, contaminated drinking sources were the main suspect for waterborne diseases, bringing Cholera and other gastrointestinal diseases to even the better off households. Lice were responsible for the spread of Typhus, while, the airless houses and the polluted atmosphere in general, played their part in breeding respiratory diseases (Gibb, 2002).

All the facts described above had a general impact on the city's health as reflected in the Crude Death Rates presented in figure 6.

Figure 6. Glasgow's Crude Death Rates, 1821-1911 (per 1,000).



Source: Based on: *Table 3.2* R. A. Cage, 1987b, p. 59.

According to figure 6, it is possible to see that Glasgow's mortality rates varied substantially throughout the period under consideration. Starting with a Crude Death Rate of around 25 per 1.000, in the period 1821-1824, Glasgow's mortality rates increased substantially over the next decades, reaching a peak of 40 deaths per 1.000 in the mid-1800s (Cage, 1987b). After a decrease in mortality over the period 1850-1860, Glasgow's Crude Death Rates remained at the point of 30 deaths per 1.000 for a decade, and, after 1871 they showed a continuous decrease, reaching a point of nearly 17 deaths per 1.000 in 1911.

Therefore, when presented schematically, it is possible to identify the negative effects of urbanization in Glasgow's mortality rates. Apart from some periods of major epidemics, which will be discussed later in this sub-section, and which subsequently increased the mortality rates, it is no coincidence that the increase in mortality happened when the majority of immigrants arrived in the city, and overcrowding became an inevitable reality. On the other hand, the decrease in mortality over the second half of the 19th century was due to the survival of a larger proportion of infants and children brought by some investments, which will be discussed later in this essay (Gibb, 2002).

As with population, and industrial growth, I will divide the discussion of mortality in the two periods mentioned earlier, the one up to 1841, and the one after 1841. Starting with the first period, it has to be mentioned that the lack of civil registration before 1855 makes it difficult to have a clear picture of the city's mortality rates, however, Flinn (1977), using the Glasgow Bills of Mortality managed to categorize the crude death rates from certain diseases over the period 1800-1865 and the results are presented in table 1.

Table 1. Share of deaths by selected diseases, Glasgow, 1800-1865.

Cause of Death	**1800-10 (%)**	**1836-42 (%)**	**1855-65 (%)**
Fever	9,8	16,1	9,5
Whooping-cough	6,8	5,3	5,6
Tuberculosis and Bronchitis	22,8	16,8	29,6
Smallpox	6,6	5	1,9
Measles	7,5	6,6	3,1
Bowel diseases	8,9	12,1	11,4
Total of above	62,4	61,9	61,1

Source: *Table 3.5* R. A. Cage, 1987b, p. 61.

According to table 1, it is possible to see that Tuberculosis and Bronchitis were the main causes of death, while other 'usual suspects' were enteric diseases, fevers and Smallpox. The important thing about table 1, however, is that over the period 1800-1865 these diseases were responsible for more than 60% of all deaths in Glasgow (Gibb, 2002; Cage, 1987b).

In terms of epidemics, Typhus and Cholera prevailed. According to Gibb (2002), Typhus existed in the city since the beginning of the 19th century; however, the huge population increase brought by in-migration turned it into an epidemic, and in fact, there were three major Typhus epidemics over the period 1801-1841. Cholera, on the other hand, first appeared in the city in 1832 and then it reappeared with two serious outbursts over the periods 1848-1849 and 1853-1854. As for Smallpox, it was almost never entirely absent from the city, while an outbreak of relapsing fever in 1843 caused 1.398 deaths (Gibb, 2002).

What is important to be mentioned is that apart from all these epidemics there was a general sickly condition in the city and, as the century progressed, this sickly condition became apparent both in the age-specific death rates and the life expectancy as shown in tables 2 and 3.

In table 2 it is possible to see the degradation of health over the period 1821-1841. In every age group it is possible to encounter higher death rates in 1841 compared to 1821. The group that catches the attention is the group of infants and children under five years old. Infant and child mortality was already high in 1821, with almost 71 deaths per 1.000; however, 20 years later, this figure had risen to 113 deaths per 1.000. This table makes even clearer the fact that, as in many other 19th century cities, in Glasgow, infants and children were the great losers in terms of health (Gibb, 2002; Cage, 1987b).

Table 2. Age-specific death rates in Glasgow, 1821-1861 (deaths in each age group per 1,000 living in each age group, both sexes).					
Age Group	**1821**	**1831**	**1841**	**1851**	**1861**
0-4	70,4	66,1	112,8	110,1	96,4
5-9	11,9	9,8	16,1	16,3	11,5
10-19	6,6	6,6	9,3	7,2	7,7
20-29	10,2	8,7	11,1	9,5	10,2
30-39	13,6	11,8	17,3	13	13,4
40-49	16,7	19,3	26	18,1	17,5
50-59	26,2	30,2	38,2	28,2	27,7
60-69	42,8	49	65,8	48,3	51,7
Over 70	117,1	151,2	160,6	126	129,8

Source: *Table 3.3* R. A. Cage, 1987b, p. 59.

Another way to understand Glasgow's sickly condition is by looking the differences in life expectancy at various ages for males and females in the two selected periods shown in table 3. Even though there is not available information concerning the life expectancy at birth over the period 1832-1841, it is obvious that people were expected on average to live less years in the 1830s than they were in the 1820s (Gibb, 2002).

Table 3. Life expectancy at various ages in Glasgow, 1821-1827 and 1832-1841 (in years).				
	Males		**Females**	
Age	**1821-27**	**1832-41**	**1821-27**	**1832-41**
0	34,12	n.a.	36,64	n.a.
10	42,27	37,4	45,24	39,94
20	35,13	30,96	38,07	33,57
30	29,4	24,9	31,23	26,9
40	23,16	19,45	24,71	21,07
50	16,86	14,53	18,31	15,86
60	11,29	9,89	12,79	11,1
70	6,75	5,95	7,93	6,8

Note: n.a: not available

Source: *Table 2.6* A. Gibb, 2002, p. 49.

From the analysis above, it could be implied that the period 1841-1914 started with a very sickly situation and a substantially increased mortality among Glasgow's inhabitants (Gibb, 2002). Over this period, the city witnessed a range of epidemics, including among others Typhus and Cholera, fevers, Smallpox and Measles[1]. However, it could be mentioned that the last major epidemic was that of Cholera in the period 1853-1855, causing almost 4.000 deaths, while, the epidemics after 1860 had a relatively more limited intensity (Gibb, 2002; Cage, 1987b). It could be implied, that the limited intensity of

[1] For those interested, table 10 in appendix provides more information.

epidemics was due to a series of investments, which will be discussed in the following sub-section. As it will be seen in chapter 6, these investments had an impact on the mortality from specific diseases and led to a decrease both in Glasgow's overall mortality and the mortality of infants and children as it can be easily seen in table 4.

Table 4. Overall mortality (per thousand) and mortality in the age group under 5 (per thousand), Glasgow, 1841-1911.

Year	Death rate (per 1,000)	Death rate under 5 (per 1,000)
1841	31	156,8
1851	38	171,3
1861	30	137,8
1871	33	160,6
1881	28	104,9
1891	25	95,9
1901	21	83,8
1911	17	61,2

Source: Based on: *Table 2.12* A. Gibb, 2002, p. 62.

According to table 4, it is possible to see that both the overall mortality and the mortality of infants and children followed a similar pattern over the period 1841-1914. Starting with high figures in 1841 and 1851, both rates started to decrease after 1861, with the exception of 1871 when, as Gibb (2002) mentions, a Measles and a Smallpox epidemic occurred. More specifically, in terms of overall mortality the period 1841-1914 started with a rate of 31 deaths per 1.000 and reached a rate of 17 deaths per 1.000 in 1911. Mortality rates among infants and children, on the other hand, showed the exact same trend, with the mortality rate starting from 156,8 deaths per 1.000 in 1841, and reaching the point of 61,2 deaths per 1.000 in 1911.

Finally, even though the numbers presented in table 4 cannot be considered as extremely low, it can be easily seen that the years after 1871 marked Glasgow's transition towards an improved life expectancy.

4.2.4 Investments[2]

As already mentioned, diseases and epidemics were 'reaping' Glasgow's population for the biggest part of the 19th century. At least for the first half of the century the public health response was extremely limited, and when it existed, it proved to be insufficient (Gibb, 2002).

In the second half of the 19th century, and after various concerns about mortality and its association with overcrowding and poor sanitation, a more systematic effort was conducted by the urban authorities (Gibb, 2002).

The investments for the sanitation of the city and its inhabitants, over the second half of the 19th century, can be divided into three major areas. Firstly, there were the investments aiming at the supply of fresh water and the

[2] For those interested in Glasgow's Public health response since 1843, detailed information is provided in table 10 in appendix.

provision of an effective sewerage system. Moreover, the urban authorities aimed at the decontamination of the existing houses, and lastly, there were investments aiming at the personal and environmental 'decontamination' (Cage, 1987b; Gibb, 2002).

In terms of water supply it has to be mentioned that during the first half of the 19th century Glasgow was dependent on public wells, whose water was of a questionable quality. However, in 1855 Glasgow's authorities approved the provision of fresh water from Lock Katrine, and in 1860 pure water became available in the city (Cage, 1987b; Gibb, 2002).

Finally, in terms of sewerage disposal, it has to be mentioned that the construction of sewers had begun since 1798 and it continued throughout the second half of the 19th century, with the upper- and middle-class districts being the first to be served. In fact, in 1850 Glasgow had 40 miles of sewers, which had grown to 100 miles by 1890 (Cage, 1987b). However, sewers emptied their contents into the River Clyde and other drinking sources and this situation did not change until the opening of the Dalmarnock works in 1894 (Cage, 1987b; Gibb, 2002).

The second set of investments in Glasgow aimed at the clearance of the existing houses. It could be said that the first systematic effort to combat the mortality associated with low-quality housing came with the City Improvement Trust of 1866 (Cage, 1987b). This act firstly aimed at the purchase of land and properties in the vastly overcrowded districts of Glasgow, and, at the acquisition of land in the less crowded districts. After the acquisition of land, the Act aimed at the demolition of the city's central slums and the erection of new tenements in the newly purchased areas of the periphery. Indeed, demolitions began in 1870 and it could be implied that the actions of the City Improvement Act managed to clear a great proportion of the city's low-quality housing areas (Cage, 1987b; Gibb, 2002). However, the erection of new tenements still could not fulfill the existing housing demand, and it has been argued that: "…the housing stock did not increase adequately, creating overcrowded conditions elsewhere." (Cage, 1987b, p. 70).

Finally, the third category of investments aimed at the personal and environmental sanitation. More specifically, the Police Act of 1862 was responsible for a series of investments during the years that followed. In fact, in 1868 a Sanitary Department was established, while, in 1870 a fever hospital was established in Belvidere. Finally, among others, over the period 1878-1884 public baths and wash-houses were opened in various city districts, while, in 1881 free treatment of fever victims was established (Cage, 1987b; Gibb, 2002).

Chapter 5: Malmö, 1800-1914

5.1 Malmö through centuries

Malmö is the third largest town of Sweden and it is situated on the southwest part of Skåne (Fridlizius, 2002; Olsson, 2001; Nilsson, 2008). The name Malmö first appeared in 1100 and it referred to what is known as the Upper Malmö. Its exact location is not known, but it is believed that it was a small village without any urban functions. The coastal city of Malmö was founded

sometime between 1250 and 1275, and it was known as the Lower Malmö (Nilsson, 2008; Malmotown, 2012).

During this period, Malmö, and the whole region of Skåne, in general, were Danish territories. The village was highly dependent on herring fishery and trade. These two features were decisive factors for Malmö's development which had grown in power already in the 1300s (Nilsson, 2008).

Malmö's power continued to grow and by the end of the 16th century, it was the second largest city of Denmark, with a flourishing trade and a population of approximately 5.000 inhabitants. However, the end of the 16th century, and the war between Sweden and Denmark, marked a period of stagnation in terms of the city's growth (Nilsson, 2008; Malmotown, 2012).

After the Peace of Roskilde, in 1658, the whole region of Skåne, including Malmö, became a Swedish territory. Swedish tariffs and other economic regulations inhibited Malmö's commercial interactions with the Danish hinterland resulting in the continuation of the city's stagnation until the end of the 18th century. However, this was not the only reason for the city's stagnation. During this period, the city had experienced the negative consequences of war and a famine, while, in the early 18th century, and in particular in 1712, the city was badly hit by a bubonic plague epidemic resulting in great population losses (Nilsson, 2008; Malmotown, 2012).

In the same year when plague was 'reaping' Malmö, a German merchant, Frans Suell, established a tobacco plant, while, at around that period a cotton textile factory and a tannery first appeared in the city. Thus, it could be mentioned that in terms of growth the term stagnation is maybe somewhat rough. Starting from the second half of the 18th century, the city was the main Scandinavian grain exporter (Fridlizius, 2002; Malmotown, 2012), and, as already mentioned, manufacturing industry played a significant financial role (Nilsson, 2008). However, according to Lars Nilsson (2008), this role "was not sufficient to create a more sustainable growth."

Finally, it could be mentioned that the road to this sustainable growth, came with the construction of Malmö's port in 1775 (Malmotown, 2012). It was only then that the city's growth reverted, paving the way for the industrialization which took place during the 19th century.

5.2 The 19th century Malmö

5.2.1 Industrialization and economic growth

As already mentioned in the previous section, Malmö's economic growth reverted at the end of the 18th century. The 19th century found Malmö to be the main grain exporter in Scandinavia, while, it had a new harbor and several manufacturing industries, namely, textiles, tannery and tobacco.

At the beginning of the 19th century the town expanded, after the demolition of its old fortifications, and it started to take the shape it has today (Nilsson, 2008; Malmotown, 2012).

In terms of trade, until the mid-nineteenth century, Malmö was mainly engaged in the domestic grain trade, while foreign trade gradually grew in

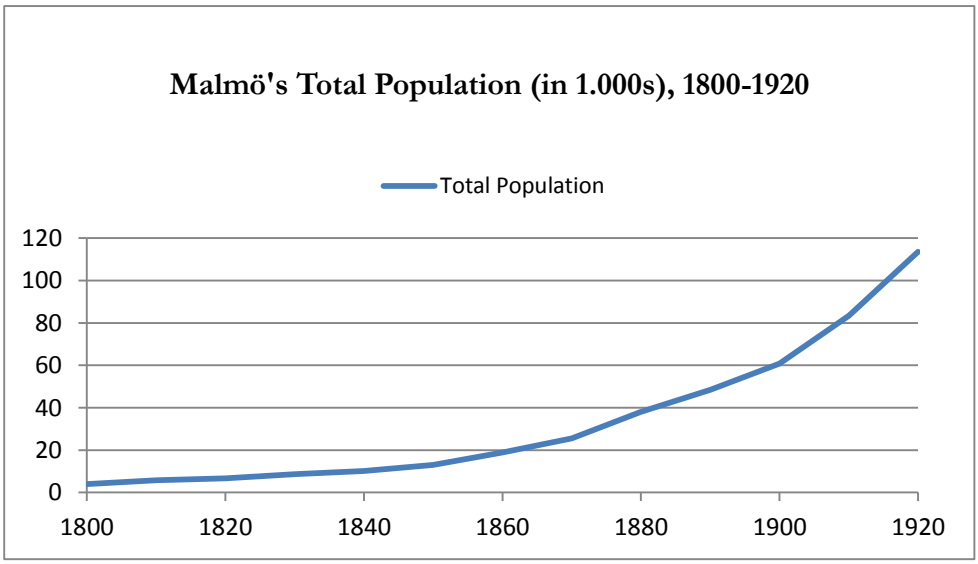
importance. As foreign trade grew in importance, so did the city's imports, concerning in particular coal from England (Nilsson, 2008; Fridlizius, 2002). Grains remained the dominant commercial commodity until the late 19th century, when they were replaced by butter, which transformed the town into one of Sweden's main ports (Fridlizius, 2002; Nilsson, 2008). Finally, it has to be mentioned that several investments were the driving forces behind the development and expansion of the city's trade, and these investments included the first regular steamboat line in the early 1850s, the construction of a railway line from Malmö in 1856, and the continuous building and modernization of the city's harbor (Nilsson, 2008; Fridlizius, 2002; Malmotown, 2012).

Finally, in terms of industry, it has been mentioned that Malmö had acquired an early manufacturing background (Nilsson, 2008). Moreover, Fridlizius (2002) mentioned, that by the mid-19th century the city's entrepreneurs started to invest in cotton-mills and soap manufacturing, while, as the century progressed the city's range of manufacturing and engineering industries increased substantially, attracting a significant amount of people.

5.2.2 Population growth and in-migration

It has been mentioned above that by the end of the 16th century Malmö had reached a population of approximately 5.000 inhabitants. However, after the 16th century and until the end of the 18th century Malmö had experienced a war, a famine and a severe bubonic plague epidemic, and all these facts had an impact on its population. In fact, figure 7 shows that at the dawn of the 19th century the city counted almost 4,000 souls.

Figure 7. Total Population (in 1.000s), Malmö, 1800-1920.



Source: Based on: *Tab. 12.*, and, *Tab. 13.* In Serien Historisk Statistik för Sverige. SCB, 1969, pp. 61-64.

Figure 7 shows a clear upward trend in terms of population over the 19th and the first two decades of the 20th. More specifically, Malmö started with a population of approximately 4.000 inhabitants in 1800, and, 20 years later it had reached a population of almost 7.000, being, as Fridlizius (2002) implied, the sixth largest town in Sweden.

Malmö's population continued to increase throughout the whole century, and by the mid-nineteenth century, it is possible to identify a clear change in the slope of the population line. This change can be explained by an increased amount of in-migration since the late 1840s (Fridlizius, 2002).

Despite the fact that these numbers are more moderate than those presented for Glasgow (see fig. 5), Malmö's population growth during the second half of the 19th century can be characterized as astonishing. Starting with approximately 13.000 inhabitants in 1850, it had reached the number of 61.000 by the end of the century, while, this number varied between 80.000 and 100.000 inhabitants at the end of the period under consideration (Fridlizius, 2002).

In terms of in-migration, due to lack of sufficient data about the city, only assumptions could be made, based on the previous research about Glasgow and other 19th century cities. Thus, we could assume that during the 19th century, Malmö presented more or less the same pattern of in-migration. Therefore, firstly it attracted in-migrants from its rural hinterland and the surrounding areas and later, after the expansion of trade and railway, it attracted many people from distant areas and from abroad (Fridlizius, 2002).

In terms of housing, finally, the available data are limited in the descriptions of several authors (Fridlizius, 2002; Olsson, 2001), however, it is possible to identify the exact same conditions as described in the case of Glasgow. Therefore, Olsson (2001) talks about brick houses for the wealthier elements of the population and crowded, unhealthy tenements for the working class, while Fridlizius (2002, p. 138) talked about "Cold barracks" and lodging houses as the main housing options for immigrants.

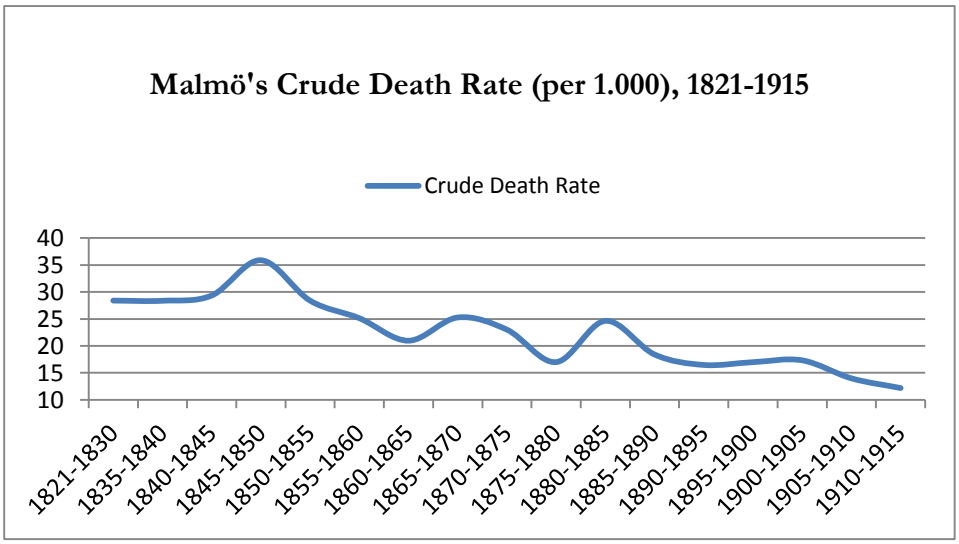
5.2.3 Health

In terms of health, it has been mentioned that Sweden's mortality decline began around the late-18th century and it occurred during three different phases (Fridlizius, 2002). Over the first two phases the rural areas exhibited a more rapid decline than the urban areas, while, over the last phase this situation reversed. The same is true about Malmö, and this sub-section will discuss the mortality decline in various age-groups for the three phases mentioned above.

More specifically, over the first period, hence the period until 1850, it is possible to identify two sub-periods. Over the years from the late 18th century and until 1821, the overall mortality declined; however, as already mentioned this decline was slower in the urban areas. Over the period 1821-1850 the mortality in the rural areas continued to decline, however, the mortality in the urban areas either stagnated, or, marked a slight decrease. The case of Stockholm is singular, as, according to Fridlizius (2002), this period marked an increase in mortality. Over the second period, 1850-1880 the overall mortality declined, however, some age-groups experienced a decrease in mortality, while some others did not. Finally, for the last period, thus the period after 1880, all age-groups experienced a decrease in mortality.

Before proceeding into the discussion of the specific periods, figure 8 will give an overall picture of the mortality decline in Malmö for the period 1821-1915.

Figure 8. Malmö's Crude Death Rate (per 1,000), 1821-1915.



Source: Based on: 1) *Tabell 6* L. Nilsson, 2008. And 2) *Table 5.13* G. Fridlizius, 2002, p. 164.

According to figure 8, it is possible to see that until around 1885 Malmö's mortality rates fluctuated a lot, but in general they had a downward trend. Starting with a Crude Death Rate of about 29 per 1.000 in the period 1821-1830, Malmö had reached a mortality rate of 25 per 1.000 in the period 1880-1885. Over this period, it is possible to see some peaks and troughs in mortality, which is completely normal keeping in mind that figure 8 presents a crude indicator of mortality. This means that high mortality levels in specific age-groups, or, perhaps epidemics had an impact on the overall mortality rate, resulting in an alteration in the shape of the mortality curve. However, after the period 1880-1885 it is possible to identify a more sustained decrease in mortality with smoother fluctuations. So, over the last two decades of the 19th century, and the first decades of the 20th, Malmö experienced a mortality decline resulting in a Crude Death Rate of approximately 12 deaths per 1.000 in the period 1910-1915.

Tables 5-8[3], provide a fuller picture of Malmö's mortality development over time, by presenting mortality by cause of death and by age group over four time periods.

Starting with infant mortality, table 5 shows that over the period 1821-1830 there were 177 deaths per 1.000. This mortality was higher than in the rural areas and Fridlizius (2002) found its cause not in nutrition differential, but in a series of other factors. Therefore, inappropriate housing, bad hygiene and breastfeeding habits were only some of the reasons which contributed to this high mortality rate (Fridlizius, 2002). These factors either directly or indirectly encouraged the occurrence of disease leading to a premature death. In fact, according to this table the most known 'killers' among this age group were the respiratory and the gastrointestinal diseases with Diarrhoea and Pneumonia to

[3] Tables 5-8 are presented in appendix.

have the primacy, while infectious diseases were responsible for a great proportion of the remaining infant deaths (Fridlizius, 2002).

More specifically, in terms of epidemic infections, the major 'killers' among infants were Whooping cough and Diphtheria accounting for 7,8 and 6,2 deaths per 1.000 respectively. The striking fact is that in table 5 there is nowhere a reference about respiratory and gastrointestinal diseases. However, there is a great proportion of deaths attributed to unknown diseases, convulsions, and strokes and violent deaths. According to Fridlizius (2002), until the 1870s a great proportion of infant deaths was categorized under one of the three 'labels' mentioned above. When trained doctors carried out a cause of death analysis by the late-19th century, they found out that many of these deaths were in fact caused to a large extent by what is known as the 'pneumonia- diarrhea complex' (Fridlizius, 2002, p. 129). Hence, table 5 confirms the fact that over the period 1821-1830 the major 'killers' among infants were gastrointestinal, respiratory and infectious diseases.

Over the period 1850-1880, there was a decline in infant mortality rates. According to the disease-specific mortality rates presented in table 6, Whooping cough continued to dominate as the major epidemic infection, while Diphtheria marked a substantial decrease. In general, all the epidemic infections presented in table 6 weakened as causes of death, with the only exception of Smallpox, which increased, causing 1,9 deaths per 1.000. Finally, in terms of non-epidemic infections, respiratory and enteric diseases continued to prevail as the major causes of death.

Finally, for the period after 1880, tables 7 and 8 show that infant mortality decreased even more. More specifically, these tables present a substantial decrease in the share of epidemic infections as the major causes of death. In fact, over the periods 1891-1900 and 1911-1914, the epidemic infections in total were responsible for approximately 5 and 4 deaths per 1.000 respectively. In terms of respiratory diseases, tables 7 and 8 present a slight decrease, while, the gastrointestinal and the congenital diseases marked an increase.

In terms of child mortality, table 5 reveals that infectious diseases were the main causes of death over the period 1821-1830, while table 6 presents that the mortality in the age groups 1-5 and 5-10 increased over the period 1850-1880 (Fridlizius, 2002). More specifically, according to table 6, over the period 1861-1870, Scarlatina and Diphtheria were the dominant causes of death among the age group 1-5. Similarly, for the age group 5-10 Scarlatina, Diphtheria and Typhoid fever prevailed (Fridlizius, 2002).

The increase in child mortality over the period 1850-1880 has been extensively discussed and it was primarily attributed to the appearance of Scarlatina and Diphtheria (Fridlizius, 2002). These two diseases, often referred to as 'new' childhood diseases, were not nutrition dependent, they could change their virulence over time, and it has been argued that they were mainly urban diseases (Fridlizius, 2002). In fact, Fridlizius (2002) mentioned that in the urban areas, these diseases together accounted for approximately 80% of child mortality from infectious diseases (Fridlizius, 2002).

More specifically, port towns like Malmö were the worst affected by these 'new' diseases and there are several explanations for this. The most dominant,

according to Fridlizius (2002), is that Scarlatina and Diphtheria were 'imported' in the city either by the increased in-migration since the 1850s, or, by the commercial contacts with England. The spread of these diseases, after they were imported, was encouraged by rapid urbanization and the development of elementary schools, which became compulsory in Sweden in 1842 (Fridlizius, 2002; Sundin and Willner, 2007).

Finally, for the period after 1880 infectious diseases, and overall mortality among children marked a decrease. In particular, over this period, nearly all the other infectious diseases gradually disappeared (Fridlizius, 2002), and in fact, over the period 1911-1914, Scarlatina and Diphtheria were the only infectious diseases left. However, their contribution in child mortality was much more moderate, and, according to Fridlizius (2002), this could either be explained by a change in their virulence or by an increase in the population's resistance to them.

Finally, tables 5-8 show that the mortality in the age groups over 10 years presented a continuous decline since 1821-1830. By observing table 5, it is possible to see that over the period 1821-1830, apart from infectious diseases, another disease dominated as the major cause of death for those aged 10 years old and above. This disease was Phthisis, it was a very common cause of death in urban areas, and as it can be easily seen, its mortality was higher among the older age groups (Fridlizius, 2002). Other popular causes of death were accidents among the working age groups and old age for those aged 50 years old and above.

As the century progressed, the epidemic infections diminished in importance and as it can be seen in table 6, over the period 1861-1870, this group of diseases was responsible for less than two deaths per 1.000 among the age groups under consideration. At the same time, Phthisis continued to have a substantial share in mortality, while, respiratory diseases were responsible for a great proportion of deaths among those aged 55 years and above.

Finally, after the 1880s the development of epidemic infections for those aged above 10 years followed the same pattern as for infants and children. In fact, according to table 7, over the period 1891-1900, epidemic infections were responsible for less than 1,5 deaths per 1.000 for the age groups under question, while, as shown in table 8, by 1911-1914 their share as a cause of death has diminished even more accounting for less than one death per 1.000.

At the same time, table 8 shows a decline in the share of Phthisis as a cause of death over the period 1911-1914, while it is possible to see a decline in respiratory diseases over the same period and a gradual increase in the mortality rates from circulation diseases especially for those aged over 60 years old.

5.2.4 Investments[4]

Before the 18th century the opinion which prevailed in all countries concerning disease was that it was the God's will. So, apart from quarantines

[4] For those interested, table 11 in appendix presents the various investments that took place in Malmö and Sweden through time.

and cordons sanitaires in periods of plague epidemics, little was done to prevent disease. This situation started to change in the 18th century when the ideas of the Enlightenment began to gain ground. More specifically, it was at that time that a new opinion appeared claiming that a man, with God's help, could prevent disease and death. This opinion, combined with the view that a country's economic development is inextricably linked to the health of its inhabitants, led to a gradual increase in the number of physicians and trained midwives all over Sweden (Sundin and Willner, 2007).

Moreover, a literacy campaign was initiated in Sweden in the first half of the 18th century, while, a systematic recording of the Swedish population and its vital statistics started as early as in 1749. This recording revealed a high mortality rate among infants and it set the cornerstones for a series of articles related to the promotion of breastfeeding and personal hygiene. These articles were published in almanacs, and, as literacy in Sweden started to increase they were read by an increasing proportion of the population (Sundin and Willner, 2007).

From the above, it can be easily seen that at the dawn of the 19th century there already existed some investments in terms of public health. In the beginning of the 19th century and in particular in 1802 Smallpox vaccination was introduced in Sweden, however, it did not become compulsory until 1816 (Fridlizius, 2002; Sundin and Willner, 2007). In addition, the campaigns promoting breastfeeding, already apparent since the 18th century, were intensified even more. Several punishments were posed to individuals who failed to comply with certain hygienic rules, while, the fumigation of houses and the burning of clothes grew in importance in periods of Cholera epidemics (Sundin and Willner, 2007).

Since the mid-19th century several investments took place including among others the introduction of compulsory schooling in 1842, a legislation concerning the sale of alcohol, and, as Fridlizius (2002) mentioned, around the 1850s several investments in cotton mills and soap manufacturing took place in Malmö. Finally, over the second half of the 19th century several investments concerning water supply and sewerage disposal took place (Olsson, 2001; Fridlizius, 2002; Sundin and Willner, 2007).

Chapter 6: Analysis

6.1 Mortality transition and response to investments, Glasgow, 1800-1914

By the discussion of Glasgow in chapter 4, it should have already been understood that the urbanization of the 19th century had a devastating effect on the health of its residents. In fact, according to figure 6, the Crude Death Rates for Glasgow increased substantially over the first half of the 19th century, and it was not until after 1850 that they started to decrease. In particular, after 1871 Glasgow's mortality rates started to decrease more rapidly, however, in 1891 these rates had only managed to reach the level of the period 1821-1824, namely, 25 deaths per 1.000.

In addition, over the first half of the 19th century the response to the public health problems was extremely limited, and when it existed, it proved to be ineffective, something that can be easily seen in the ever increasing mortality rates presented in figure 6.

Over the second half of the 19th century, a more systematic effort to prevent disease took place. Public health response over that period included a variety of investments which can be easily seen in table 10 in appendix. Briefly, the most important of them included the provision of fresh water from Lock Katrine in 1860, the construction of more sewers, the City Improvement Trust of 1866 and the Police Act of 1862.

In order to evaluate the efficiency of these investments, total deaths from major diseases have been used over the period 1855-1914 and they are presented in table 9[5].

Starting with Smallpox, table 9 indicates that over the period 1855-1859 there were approximately 1.000 deaths from this disease, while there was a peak in mortality over the period 1860-1864. After 1864, however, it is possible to see a decline in Smallpox mortality interrupted only in two periods where a Smallpox epidemic occurred.

Compulsory vaccination against Smallpox was introduced in Scotland in 1863. According to Gibb (2002) Smallpox vaccination was quite delayed compared to England (1853), and there is no need to make the comparison with Sweden, which introduced a compulsory vaccination law as early as in 1816. In fact, this delay, according to Gibb (2002, p. 63), in combination with an "extremely lax enforcement of regulations" were the main reasons for the delayed decline of Smallpox

However, according to table 9 it can be easily seen that Smallpox presented an astonishing decline in the first five years after the introduction of the vaccination law. Over the period 1870-1874, a period when an epidemic occurred, Smallpox was responsible for approximately 800 deaths, while over the period 1900-1904 it caused 400 deaths.

From the above it is possible to see that vaccination had an effect against Smallpox, however, it did not manage to eliminate it, at least until 1904. It surely managed to put it under control by reducing its fatality and, in fact, over the period 1875-1899 deaths from Smallpox were minimal. This decline coincides with the provision of proper isolation in the permanent Smallpox hospital in Belvidere in 1878, so, it could be implied that vaccination and isolation helped to keep Smallpox deaths at low levels over that period.

Finally, the fact that Smallpox seems to disappear after 1904 can be attributed to a higher proportion of children being vaccinated; something that was not

[5] Table 9 is presented in appendix.

the case during the earlier periods, especially for Catholics who were opposed to vaccination (Gibb, 2002).

In terms of Cholera and other gastrointestinal disorders table 9 does not enable us to have a clear view of their development and this is because it presents the total deaths from these three diseases together.

According to this table, it is possible to see a decline in deaths coinciding with the period when Glasgow gained access to fresh water from Lock Katrine. According to Gibb (2002) the biggest part of this decline was attributed to Cholera. In fact, the Cholera epidemic of 1853-1855 caused 3.885 deaths, while, in 1866 it caused only 53 deaths. From the above, it can be easily seen that fresh water supply was a serious blow for Cholera's fatality (Gibb, 2002).

In terms of Dysentery and Diarrhoea, however, the results were not so remarkable. In fact, according to table 9 it is possible to see that the total deaths for the period 1860-1899 varied between 1.500 and 2.500, and it was not until around 1900 that they started to decline (Gibb, 2002).

A possible explanation for this could be found in the sewerage treatment and disposal. It has already been mentioned, that sewer construction in Glasgow dates back in 1798. The construction continued throughout the 19th century, however, all the effluents were thrown into Clyde and other streams. Proper sewerage treatment and disposal did not occur until the opening of Dalmarnock works in 1894 (Cage, 1987b; Gibb, 2002), and this could explain both the persistence of Dysentery and Diarrhoea, throughout the 19th century, and their decline after 1900.

In terms of Typhus, the effects of several investments are more pronounced as it can be easily seen in table 9.

The provision of fresh water in the city in 1860 encouraged a more frequent washing of people and clothes and it had an effect on Typhus fatality. More specifically, a Typhus epidemic in 1847 was responsible for more than 4.000 deaths, while, the epidemics of 1864 and 1865, when fresh water existed in the city, caused a little more than 1.100 deaths each (Gibb, 2002).

However, according to Gibb (2002) reinfection was a commonplace and this was because of the persistent use of unhygienic houses and infected used clothes. In 1866, a year after a Typhus epidemic, the City Improvement Trust was enacted. The demolition of the city's central slums in 1870, the provision of fever hospitals in the same year and the construction of public baths and wash-houses over the period 1878-1884 managed to put Typhus under control by the 1880s. In fact, according to table 9 it can be easily seen that Typhus caused 194 deaths over the period 1880-1884, while for every five-year period after 1884 it caused less than 100 deaths.

In terms of Scarlet Fever, table 9 presents a decline in mortality after the period 1870-1874. However, according to Gibb (2002), this decline cannot be linked to any set of investments and the most logical explanation can be found in a change in the virulence of the disease. This spontaneous decline cannot be observed, however, in diseases such as Measles, Whooping cough and Diphtheria.

In terms of Measles and Whooping cough, no substantial change in their fatality can be observed until 1914, while, Diphtheria presented a slight decline after 1889.

According to Easterlin (1999), the Diphtheria vaccine was developed by Von Behring in 1892, and, if I had data on the exact date of its introduction in Glasgow I would probably be able to make a connection between the decline in Diphtheria mortality and this introduction. However, keeping in mind, firstly, the delayed introduction of Smallpox vaccination, and secondly, the fact that Diphtheria does not show any significant decline, I tend to believe that this slight decline was attributed, as in the case of Malmö, either in a change in the virulence of the disease, or, in an improved population's resistance to this disease (Fridlizius, 2002).

In addition, in terms of Enteric fever, also known as Typhoid fever, table 9 indicates a steady decline after 1869. Typhoid fever was mainly transmitted through contaminated food or water and it could be implied that the fresh water supply had an effect on its fatality.

After 1884 Enteric fever showed a more pronounced decline accounting for less than 1.000 deaths for every five-year period. The fact that over the period 1884-1914 Typhoid fever presents some fluctuations in terms of its fatality could be attributed to some epidemics, however, the data presented in table 10 do not confirm such an assumption.

Finally, the last major diseases that have to be mentioned are the respiratory diseases. In fact, as Gibb (2002) mentions, one of the main goals of the City Improvement Trust was to defeat such diseases. According to Gibb (2002, p. 65) Tuberculosis "… responded to official intervention…"; however, table 9 shows no remarkable decline in the mortality from Phthisis and Pulmonary Tuberculosis, unless if it is seen as an improvement the fact that from a little over than 9.500 deaths over the period 1865-1869, mortality from Phthisis and Tuberculosis fell to a little more than 8.000 deaths over the period 1890-1894. After the turn of the century, it could be implied that there is a more sustained decline, however, it can be easily seen that even then these two diseases had the primacy in terms of mortality.

In terms of Bronchitis and Pneumonia finally, table 9 indicates a small decrease after 1884, however, according to Gibb (2002, p. 65) these diseases "… proved to be much more resistant and frequent outbreaks of epidemic proportions continued to occur well beyond the turn of the century."

6.2 Mortality transition and response to investments, Malmö, 1800-1914

In chapter 5, the mortality development in Malmö was examined. The discussion has so far shown that unlike Glasgow, Malmö's industrialization had a relatively more benign impact on the health of its inhabitants. In fact, it has been argued that only over the period 1850-1880 Malmö's role as a port-town affected the health of its residents (Fridlizius, 2002). Despite this fact, however, figure 8 showed a clear downward trend in mortality during the whole period under consideration.

It has been argued that three distinct phases can be observed in the Swedish mortality decline and this exact same pattern can also be found in the city of Malmö (Fridlizius, 2002). The specific characteristics of each phase have already been discussed, however, the important things to keep in mind is, firstly, that until 1880 the mortality decline in rural areas was more rapid than that in the urban areas, and secondly, that over the period 1850-1880, even though the overall mortality declined, this was not the case for certain age groups (Fridlizius, 2002).

Table 11 clearly indicates that there were several investments in Sweden already in the 18th century, however, unlike Glasgow; figure 8 does not permit us to make any assumptions about their efficiency. Therefore, the examination of the three time periods will be needed.

Starting with the first period, hence the period until 1850, it is possible to identify a decline in overall mortality driven by reductions in infant and child mortality.

According to table 11, the most important investments of the early 19th century were the campaigns promoting breastfeeding and child care, the construction of sewerage canals and the introduction of compulsory Smallpox vaccination in 1816.

In terms of the mortality decline of infants and children, some credit could be given to the official campaigns promoting breastfeeding and child care. However, as Fridlizius (2002) mentioned, the beneficial effect of such campaigns was most pronounced in the rural areas, while, in the urban areas this effect was offset by the prevailing unsanitary conditions. Thus, it cannot be concluded that such campaigns were the driving force behind the mortality decline in urban areas over this period.

In addition, the construction of sewerage canals around 1800s was at a very initial stage, and keeping in mind that all the effluents were emptied in Malmö's central canal, there is no doubt that they were ineffective as well. To this conclusion consents also the fact that Diarrhoea and other gastrointestinal disorders prevailed as the major cause of death among infants (Fridlizius, 2002; Olsson, 2001).

Finally, the introduction of Smallpox vaccination in 1816 proved to be effective, however, its contribution concerns solely the period after its introduction. More specifically, Smallpox was a disease which had a lot of serious complications. Apart from its apparent side effects, it reduced immunity making people vulnerable to other epidemics (Fridlizius, 2002). Hence, the vaccine introduction played an important role in the mortality decline not only in 1816, but also, during latter periods. However, this vaccine cannot take credit for the overall Smallpox mortality decline. In fact, Smallpox mortality in Sweden began to decline since the mid-18th century. Over that period, Smallpox inoculation existed, but it was extremely limited (Sundin and Willner, 2007), therefore, it cannot be concluded that it had any significant effect on this reduction.

Concerning the period 1850-1880, the analysis for Malmö showed a decline in overall mortality, something that was not the case, however, for all age groups.

In particular, infants and adults experienced a mortality decline, while children experienced an increase in their mortality.

In the case of infants, improved hygiene and increasing imports of coal from England were the main reasons for the mortality decline from the diarrhoea – pneumonia complex. At the same time, the increased number of midwives and doctors over this period improved the health of women, leading not only to a higher survival of mothers, but also, to healthier infants (Fridlizius, 2002).

In the case of adult men the main decrease in mortality can be attributed to a legislation concerning alcohol sale. It has been argued that excess male mortality in the rural areas was attributed to excess alcohol consumption, and as Fridlizius (2002) mentioned, this must have been even more the case in the urban areas where alcohol was easily available. Thus, with the legislation introduced in the early 1850s we could assume that a great proportion of alcohol-related deaths among men were averted, leading to a decline in overall adult mortality.

Finally, for the period after 1880 a decrease in mortality was marked in all age groups. In terms of infant mortality it has been argued that improvements in water supply and sewerage disposal were the driving forces behind the decrease in gastrointestinal disorders (Fridlizius, 2002). These diseases weakened the immunity of infants making them vulnerable to other diseases. Thus, their decline certainly affected the overall mortality rates. However, as it can be easily seen in table 11, water supply and sewerage disposal in Malmö was extremely delayed as the process faced many impediments mainly due to conflicting interests (Fridlizius, 2002; Olsson, 2001). This delay kept Malmö's mortality from digestive diseases extremely high even at the end of the period under consideration (Fridlizius, 2002).

Moreover, in terms of child mortality, and in particular in the case of Scarlatina and Diphtheria, no investment seems to have contributed to this decline. As already mentioned these diseases could change their virulence over time and they were unaffected by changes in nutrition. Thus, the only possible explanation for their decline can be found in a change in their virulence that was 'friendlier' to the human host (Fridlizius, 2002).

Lastly, in terms of adult mortality some credit should be given again to the regulation for alcohol consumption introduced in the early 1850s and reinforced by the decision concerning the liquor sale by government controlled companies from 1905 onwards (Sundin and Willner, 2007). In fact, according to Fridlizius (2002), excess male mortality over the period 1911-1914 was much lower compared with previous periods. However, this was not the only reason. Over this period a series of other investments took place. More specifically, regulations concerning occupation certainly contributed to the decline in adult mortality. In addition, improved housing conditions brought by a boom in building industry helped in the reduction of respiratory diseases; while, finally, the expansion of midwifery services and the introduction of antiseptic techniques during childbirth enabled more women to survive, contributing to a decline in overall mortality (Fridlizius, 2002; Sundin and Willner, 2007).

6.3 Comparison and discussion of results

The analysis of Malmö and Glasgow revealed not only similarities, but also a lot of differences between these two cities. The negative effects of urbanization were more pronounced in the case of Glasgow; however, it could be argued that the size of the city is a significant factor which consents to this fact (Fridlizius, 2002). In fact, in the beginning of the 19th century, Glasgow's population was twenty-fold that of Malmö's. Therefore, the negative effects of urbanization were reflected in the city's increased mortality rates during the first half of the century. In Malmö, on the other hand, these effects were less pronounced. Over the whole period, the city presented a decline in mortality, and in fact, it has been argued that only during the period 1850-1880 its role as a port city seems to have influenced its mortality rates. However, even in this case, only the age-specific mortality was influenced, while its crude mortality continued to decline.

In addition, tables 10 and 11 presented a series of investments that took place over that period. Some of them proved to be effective while some others did not, but there is no doubt that a large part of the mortality decline before the advancement of modern medicine can be attributed to a range of investments.

In the case of Glasgow, the analysis showed that over the first half of the 19th century, the investments were very limited and they did not manage to affect mortality. Their contribution in the mortality decline began after the second half of the century and proved to be quite remarkable. In particular, the investments aiming at the sanitation of the city, in combination with those aiming at the decontamination of the existing houses, and the investments concerning health managed to put under control a great proportion of the major 'killers' of this period, leading to an improved life expectancy.

In the case of Malmö, on the other hand, table 11 revealed a series of investments already apparent since the 18th century. However, even though there was a mortality decline since the mid-18th century, the analysis showed that until around 1850 it was not influenced by investments. In fact, it has been mentioned that this early decline was due to factors beyond human control such as climate changes and, for the case of Smallpox in particular, a spontaneous change in the relationship between infectious agent and host (Fridlizius, 2002). As already mentioned, some credit could be given to the introduction of Smallpox vaccination in 1816; however, its introduction cannot explain the overall mortality decline apparent in this period. Over the second half of the century, the mortality decline could, in a large extent, be attributed to human intervention, and in fact, the analysis showed that regulations concerning alcohol sale, water sanitation, improved housing and improvements in the health sector were only some of the investments which managed to put diseases under control and raise life expectancy especially after 1880.

In addition, even though it is possible to see more or less the same investments taking place in those two cities over the course of the 19th century, the analysis did not reveal the appearance of a similar pattern. For instance, both cities tried to improve their existing houses; however, this took place in Glasgow in 1866, while in Malmö the improvement in housing took place in the late-19th/ early-20th century. Therefore, even if improved housing can explain the

mortality decline in Glasgow, this cannot be the case for Malmö because a sustained mortality decline was already apparent before the boom in the building industry. The same is true about the construction of a sewerage disposal system, the introduction of vaccines and many other investments. In all cases when those investments took place they had some effect, however, no common 'ingredient of success' can be found that can explain the reason behind the sustained mortality decline which happened almost at the same time in these two cities. It can be concluded thus that each city followed its own path by choosing specific sets of investments that managed to combat its key problems and lead to a sustained mortality decline.

Finally, one of the questions posed in this paper was whether it is possible to identify which investment proved to be more effective. And the answer given by the analysis so far is that no investment by itself can take credit for the whole mortality decline. It was the combination of investments that managed to eliminate certain diseases and led to an increased life expectancy.

For instance, the investment which proved to be more effective in the decline of Cholera mortality is the provision of fresh water. However, water supply without appropriate sewerage treatment cannot by itself lead to an elimination of the other enteric diseases, and this was shown both in Glasgow and Malmö. Moreover, in the case of Glasgow the analysis showed that Typhus was not eliminated by the provision of fresh water only. On the contrary, it took several other investments to put it under control. At the same extent, the introduction of a vaccination law cannot by itself make the difference in terms of mortality; campaigns for the information of the public about the benefits of vaccination are needed as well.

Lastly, it has been shown that there was a strong synergy between diseases; thus, an investment cannot be characterized as effective based only on the effect it had on a certain disease. For instance, in the case of Chicago the provision of fresh water managed to eliminate the mortality associated with Typhoid fever. In fact, Typhoid fever accounted for 7% of all deaths over the period 1870-1879 and for 0% over the period 1915-1925. As it can be easily seen from the above Typhoid fever accounted for a small percentage of total deaths. Based only on this observation, someone could conclude that water supply was effective in reducing Typhoid's mortality, but it could not explain the overall mortality decline. However, research has shown that Typhoid fever had many serious complications which caused other health problems to its survivors. When Typhoid fever was eliminated, so did its serious complications. Therefore, fresh water supply in Chicago proved to be more effective than it appears from the percentage reduction in Typhoid's mortality (Ferrie and Troesken, 2005; Ferrie and Troesken, 2008).

Finally, like Mc Keown and his associates (1972), I will give my own opinion for the increase in life expectancy before the advancement of modern medicine. This opinion will be based on the analysis of Malmö and Glasgow and I will try to construct a priority order using the following elements: improved nutrition, sanitation revolution, spontaneous decline and germ theory of disease.

The analysis so far, has shown that there were two main categories of diseases. First, there were the diseases which followed their own rules and were not sensitive to nutrition or any other human intervention. These diseases could change their virulence over time and they could cause peaks or troughs in mortality. On the other hand, there were certain diseases which could be enhanced by human intervention and therefore, they could also be put under control with the appropriate measures.

In terms of improved nutrition, I tend to agree with Easterlin's (1999; 1995) opinion. Hence, that its benefits were counterbalanced by the general unhealthy conditions prevailing in urban areas. In fact, the analysis of Glasgow and Malmö did not show any significant association between nutrition and mortality, at least for the first half of the 19th century. More specifically, Glasgow over the 19th century was at its peak in terms of power and glory, however, its mortality increased over the first half of the century. In the same respect, Fridlizius (2002) mentioned that in many cases he was not able to find a link between living standards and mortality in Malmö, and in fact, he argued that when child mortality increased over the period 1850-1880, there was no evidence for any deterioration in living standards.

Keeping these in mind, and assuming that people could do nothing about the first category of diseases, I would conclude that the most important explanation for the increase in life expectancy before the advancement of modern medicine is the investments associated with the sanitation revolution. These investments managed to put under control major diseases of the 19th century which were responsible for a great amount of deaths. Then, and only when the general unhealthy situation in the cities was put under control, the benefits of improved nutrition could be reflected in a further reduction of mortality. The vaccines and antitoxins developed thanks to the germ theory of disease come in the third place and this is because the analysis showed that they were not widely accepted and in many cases their introduction was quite delayed. Lastly, the spontaneous decline in mortality seems to be the least powerful explanation for the increase in life expectancy and this is because it may be true for certain diseases; however, there is no evidence that it was responsible for the overall mortality decline.

Chapter 7: Conclusions

The stimulus for this essay was given by the fact that life expectancy in certain countries started to increase long before the development of modern medicine. In particular, in England and Wales the rapid increase in life expectancy started in 1871, while, in Sweden this transition began in the mid-nineteenth century.

Having as a principal axis the so called 'urban penalty', the analysis was limited in two port cities; Glasgow and Malmö. Data on crude, age-specific and disease-specific mortality were used over the period 1800-1914 in order to identify the mortality development of these two cities. In addition, data on various investments were used for the two cities mentioned above. All these combined, tried to answer a principal question concerning whether the reduction in mortality before the advancement of modern medicine was associated with investments. If the answer to this question was positive, two secondary questions were raised concerning firstly, which investment proved

to be more effective, and secondly, if there was an investment that could be described as a 'common ingredient of success'.

The analysis of these two cities revealed many similarities and differences, making evident that they did not experience urbanization in the same way. A fact, that confirmed the view that the level of mortality is closely related to the size of the city. In fact, urbanization had a devastating effect on the health of Glasgow's inhabitants, and this was mirrored in an increased mortality rate; while, urbanization in Malmö had a milder effect, and in fact the whole period under consideration was characterized by a continuous decline in overall mortality.

Concerning the principal question, the analysis showed that undoubtedly the mortality decline over the second half of the 19th century in these two cities was driven by investments. Now, concerning the question about which investment proved to be more effective; the analysis did not reveal any 'winner'. Apart from the eradication of specific diseases by certain investments (see for example the decline in Cholera mortality in Glasgow, or the decline in Smallpox mortality after 1816 in Malmö), it was the combination of investments that led to an increased life expectancy before the development of modern medicine.

Finally, as already mentioned, another desired outcome of this research was to examine whether there was a key investment, which would be common in both cities and could explain why their mortality decline occurred almost at the same time. However, the analysis failed to answer this question, and in fact, even though it is possible to find common investments in both cities, they do not coincide in time. Therefore, it can be concluded that each city followed its own path that led eventually to a reduction in mortality, and that there was not a common 'ingredient of success'.

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Appendix

Table 5. Mortality per 1,000 from different causes of death in different age groups, Malmö, 1821-1830.

Cause of death	**0-1**	**1-5**	**5-10**	**10-25**	**25-50**	**50+**	**All age groups**
Smallpox	0,4	-	0,2	n.a.	n.a.	n.a.	n.a.
Scarlatina	5,4	2,6	1,4	n.a.	n.a.	n.a.	n.a.
Measles	4,9	6	1,1	n.a.	n.a.	n.a.	n.a.
Diphtheria	6,2	3,5	0,5	n.a.	n.a.	n.a.	n.a.
Whooping cough	7,8	2,2	0,3	n.a.	n.a.	n.a.	n.a.
Typhoid fever	4,5	4,4	2,8	n.a.	n.a.	n.a.	n.a.
Dysentery	-	-	-	n.a.	n.a.	n.a.	n.a.
Epidemic infections	**29,2**	**18,7**	**6,3**	**2,6**	**4,2**	**4,4**	**6,3**
Phthisis	0,4	0,6	0,7	1	4,4	6,2	2,8
Inflamation fever	1,2	1,7	0,4	0,4	0,9	1,2	0,9
Remittent fever	3,3	0,2	0,4	0,1	0,3	0,4	0,3
Rickets	4,5	1,6	1,1	n.a.	n.a.	n.a.	n.a.
Convulsions	13,6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Stroke/ violent death	30,9	4	0,4	0,1	1,1	2,3	0,1
Unknown	89,3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Dropsy	n.a.	n.a.	n.a.	0,3	0,8	2,5	0,8
Pine away disease	n.a.	n.a.	n.a.	0,3	2,7	7,5	2,1
Accidents	n.a.	n.a.	n.a.	0,7	2,5	2,7	1,4
Child bed fever	n.a.	n.a.	n.a.	n.a.	0,3	n.a.	n.a.
Old age	n.a.	n.a.	n.a.	n.a.	n.a.	34,5	5,3
Other	4,6	5,9	1,9	0,7	2	3,2	8,4
Total	**177**	**32,7**	**11,2**	**6,2**	**19,2**	**64,9**	**28,4**

Notes: n.a.: not available

Source: Based on: Table 5.13. G. Fridlizius, 2002, pp. 158-164.

Table 6. Mortality per 1,000 from different causes of death in different age groups, Malmö, 1861-1870.

Cause of death	**0-1**	**1-5**	**5-10**	**10-20**	**20-35**	**35-55**	**55+**	**All age groups**
Smallpox	1,9	0,5	0,1	n.a.	n.a.	n.a.	n.a.	n.a.
Scarlatina	4,1	9,8	3,1	n.a.	n.a.	n.a.	n.a.	n.a.
Measles	3,9	4,1	0,6	n.a.	n.a.	n.a.	n.a.	n.a.
Diphtheria	3,2	5,9	1,2	n.a.	n.a.	n.a.	n.a.	n.a.
Whooping cough	6,7	2,3	-	n.a.	n.a.	n.a.	n.a.	n.a.
Typhoid fever	3,6	2,8	2,2	n.a.	n.a.	n.a.	n.a.	n.a.
Dysentery	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Epidemic Infections	**23,4**	**25,4**	**7,2**	**1,4**	**1,3**	**1,1**	**1,7**	**5,2**
Phthisis	2,3	2,7	1,8	1,3	2	3,6	9,6	2,7
Congenital	27,1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Digestion	16,5	3,1	0,1	0,3	0,3	0,6	2,4	1,4
Respiration	29,7	8,5	1	0,2	0,9	2,7	15,9	4,1
Circulation	n.a.	n.a.	n.a.	0,2	0,3	0,6	3,2	0,8
Nervous system	n.a.	n.a.	n.a.	0,2	0,2	0,7	4,6	2,3
Accidents	n.a.	n.a.	n.a.	0,2	0,9	0,7	1,4	0,6
Other	46,1	8	3	0,9	1,6	5,3	17,7	4,9
Total	**145,1**	**47,7**	**13,1**	**4,7**	**7,5**	**15,3**	**56,5**	**22**

Notes: n.a.: not available

Source: Based on: Table 5.14. G. Fridlizius, 2002, pp. 165-172.

Table 7. Mortality per 1,000 from different causes of death in different age groups, Malmö, 1891-1900.

Cause of death	**0-1**	**1-5**	**5-10**	**10-20**	**20-40**	**40-60**	**60+**	**All age groups**
Smallpox	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Scarlatina	0,1	0,7	1,2	n.a.	n.a.	n.a.	n.a.	n.a.
Measles	0,5	0,5	0,3	n.a.	n.a.	n.a.	n.a.	n.a.
Diphtheria	1,1	5,7	1,9	n.a.	n.a.	n.a.	n.a.	n.a.
Whooping cough	2,9	1,6	0,1	n.a.	n.a.	n.a.	n.a.	n.a.
Typhoid fever	-	0,1	0,1	n.a.	n.a.	n.a.	n.a.	n.a.
Dysentery	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Epidemic Infections	**4,8**	**8,6**	**3,6**	**0,5**	**0,5**	**0,5**	**1,4**	**1,5**
Phthisis	0,8	1,2	0,7	1,1	3,1	4,1	6,1	2,6
Congenital	31,5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Digestion	34,5	1,7	0,9	0,3	0,4	0,8	2,8	1,7
Respiration	28,4	4,5	0,4	0,3	0,4	1,7	13,9	2,7
Circulation	n.a.	n.a.	n.a.	0,4	0,5	1,7	4,6	0,9
Nervous system	n.a.	n.a.	n.a.	0,3	0,3	1,3	4,9	1,3
Accidents	n.a.	n.a.	n.a.	0,1	0,3	0,4	0,7	0,3
Other	27,2	7,3	2,4	0,5	0,7	3,2	22,2	5
Total	**127**	**23,3**	**8**	**3,5**	**6,2**	**13,7**	**56,6**	**16**

Notes: n.a.: not available

Source: Based on: Table 5.14. G. Fridlizius, 2002, pp. 165-172.

Table 8. Mortality per 1,000 from different causes of death in different age groups, Malmö, 1911-1914.

Cause of death	**0-1**	**1-5**	**5-10**	**10-20**	**20-40**	**40-60**	**60+**	**All age groups**
Smallpox	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Scarlatina	0,7	1,2	0,6	n.a.	n.a.	n.a.	n.a.	n.a.
Measles	0,4	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Diphtheria	0,7	1,1	0,4	n.a.	n.a.	n.a.	n.a.	n.a.
Whooping cough	2	0,5	-	n.a.	n.a.	n.a.	n.a.	n.a.
Typhoid fever	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Dysentery	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Epidemic Infections	**3,8**	**2,8**	**1**	**0,4**	**0,5**	**0,3**	**0,2**	**0,9**
Phthisis	0,7	1,2	0,8	0,6	2	2,3	3,6	1,7
Congenital	30,6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Digestion	28,8	0,9	0,2	0,1	0,3	0,5	2	1,3
Respiration	24,3	2,7	0,3	0,2	0,4	1,3	9,1	2,1
Circulation	n.a.	n.a.	n.a.	0,6	0,6	2,1	13,5	1,7
Nervous system	n.a.	n.a.	n.a.	0,3	0,3	1,3	4,9	1,7
Accidents	n.a.	n.a.	n.a.	0,2	0,3	0,7	0,6	0,4
Other	11,8	3,2	1,1	0,1	0,8	3,3	24,5	3,1
Total	**100**	**10,8**	**3,4**	**2,5**	**5,2**	**11,8**	**58,4**	**12,9**

Notes: n.a.: not available

Source: Based on: Table 5.14. G. Fridlizius, 2002, pp. 165-172.

Table 9. Total deaths from major diseases, Glasgow, 1855-1914.					
Period	**Disease**				
	Diarrhoea, dysentery, cholera	***Typhus***	***Enteric fever ****	***Scarlet fever***	***Diphtheria***
1855-1859	2719	2333	-	2427	757
1860-1864	1330	3225	-	2343	1570
1865-1869	2053	3607	1140	3210	1154
1870-1874	2092	1191	1111	3397	1557
1875-1879	1968	352	1097	1622	1388
1880-1884	1885	194	1032	1862	1475
1885-1889	1440	97	497	1161	1302
1890-1894	1609	61	617	1163	999
1895-1899	2500	49	883	878	590
1900-1904	-	44	599	430	521
1905-1909	-	10	395	483	820
1910-1914	-	13	271	807	862

(Continued in the next page)

Table 9. *(continued)*

Period	Disease				
	Measles	***Whooping cough***	***Bronchitis, pneumonia***	***Pthisis, pulmonary tuberculosis***	***Smallpox***
1855-1859	1657	3163	4355	6493	1043
1860-1864	1817	3214	5984	8298	1115
1865-1869	2020	3262	6323	9665	167
1870-1874	2001	3083	6721	9566	775
1875-1879	1449	3362	6777	9118	25
1880-1884	1880	3437	5866	6335	23
1885-1889	1677	3144	5360	7048	8
1890-1894	2654	2985	5298	8290	38
1895-1899	2949	3205	4797	7229	30
1900-1904	1990	3115	4824	6960	424
1905-1909	2540	2805	3592	6415	-
1910-1914	2815	3156	3206	4464	-

Note: a) Dashes (-) denote zero.

b) *: According to R. A. Cage (1987b, p. 73), "Enteric Fever was not separately registered till 1865."

Source: Based on: Table 2.13. A. Gibb, 2002, p. 64.

Table 10. Epidemic disease and the public health response in Glasgow, 1843-1910.			
Year	**Disease**	**Year**	**Public health response**
1843	Relapsing fever (1.398 deaths)	1843	Police Act: Inspector of Cleansing (streets and public places appointed).
1847	Typhus (4.346 deaths)	1846	Nuisance Removal (Scotland) Act.
1848/9	Cholera (3.772 deaths)	1848	Gravitation water supply to Gorbals (private).
1851	Typhus		
1853/5	Cholera (3.885 deaths)	1853	Compulsory infant vaccination (smallpox): not enforced.
		1855	Lock Katrine Act: Scottish Registration Act (compulsory registration of disease).
		1856	Nuisance Removal (Scotland) Act (amended).
		1857	Committee on Nuisances.
		1859/60	Lock Katrine Scheme - fresh water to city.
		1861	Police Act: Sanitary Department set up and Medical Officer of Health appointed.
		1863	Ticketed' houses.
1864	Typhus (1.138 deaths)	1864	First municipal disinfecting and washing-house in High Street. Vaccination Act.
1865	Typhus (1.177 deaths)	1865	First municipal fever hospital in Parliamentary Road.
1866	Cholera (53 deaths)	1866	Police Act (sanitary clauses): City Improvements Act (housing).
		1867	Public Healt (Scotland) Act.
1869	Typhus (970 deaths)	1870	Sanitary Department extended. Temporary fever hospital, Belvidere.
1870	Relapsing fever	1872	First reception house for families of typhus victims.
1873	Relapsing fever* (228 deaths)	1873	City Improvements Amended Act; vaccination station opened.
1875	Typhoid and enteric fever*, Camphill		
1877/8	Enteric fever*, West End	1878	Permanent smallpox hospital, Belvidere. First proper isolation.
		1878/84	Opening of district baths and wash-houses.
		1879	Dairies and Milkshops Order.
1880	Enteric fever*, North and Central	1880	City Improvements Amendment Act.

Table 10. *(continued)*

Year	Disease	Year	Public health response
		1881	Free treatment for fever patients. Returns of vaccination defaulters; first refuse destructor (further provision in 1884, 1890, 1894, 1897, 1902).
		1883	Washing and disinfection station, Belvidere.
1884	Enteric fever*, hospitals	1889	Infectious Disease (Notification) Act.
1888	Scarlet fever*, Garnethill	1890	Housing of the Working Classes Act (Part V. Scotland)
			Glasgow Police Amendment Act (water closet provision).
1892	Scarlet fever*, Paisley Road	1892	Glasgow Building Regulations Act: Runchill fever hospital started.
			Further Powers Act (smoke penalties).
1893/4	Scarlet fever*, Kelvinside	1894	First sewage purification unit, Dalmarnock; disinfection station, Ruchill
		1897	Public Health (Scotland) Act: Glasgow Corporation (Improvements etc.) Act.
1900	Smallpox	1904	Sewage purification works, Dalmuir and Patrick.
		1907	Notification of Births Act: Glasgow Infant Health Visitors Association.
		1908	Children Act.
		1910	Kinning Park and Shieldhall sewage purification works.
		1911	Health Insurance.
		1912	Notification of pulmonary tuberculosis.
		1914	Notification of all forms of tuberculosis.
		1915	Maternity and Child Welfare Schemes: Act for training and supervision of Midwives.

Notes: *: infected milk source.

Source: Based on: Table 2.11. A. Gibb, 2002, pp. 58-59

Table 11. Investments in Malmö and Sweden through time.	
Period/ Year	**Investment**
Before 17th century	Use of quarantines and cordons sanitaires to prevent Plague and other epidemics.
17th century	Small number of provincial doctors.
First half of 17th century	Literacy campaign in some parishes (soon spread to the whole country).
1663	Collegium Medicum established.
1686	First decree issued by Collegium Medicum ('traditional birth attendants' and training courses for midwives in Stockholm).
18th century	Expansion of the system of provincial doctors and midwives; Information campaigns for breastfeeding and infant care; Inoculation prescribed by provincial doctors; 'Priest medicine': a course in medical skills for theology students aiming at the improvement of health in rural areas; Inoculation campaigns (sporadic and limited).
Early 18th century	Fumigation of plague-infested houses, isolation, quarantine, cordons sanitaires and control of visitors. (Skåne)
1739	Royal Swedish Academy of Sciences is founded. It is a scientific society whose task is to discuss reports concerning public health improvements etc. Uppsala Science Society also known.
1744	First constitution of Collegium Medicum established.
1749	Tabellverket established. Collection of vital statistics by parish priests.
1764	Nils Rosén von Rosenstein → *"The Diseases of Children and their Remedies"*. His book contained advice and information about public health. It included among others medical prescriptions, information about breastfeeding and wet nurses, diseases of children etc.
1753-1771	Rosén's articles can be found in annual Swedish almanacs over that period. As literacy increases in Sweden these articles become widely read.
19th century	Breastfeeding campaigns in various parts of Sweden.
Early 19th century	Sewerage canals dug in Malmö; punishment for citizens breaking certain hygienic laws in Linköping.
1802	Smallpox vaccination successfully introduced.
1813	National Board of Health established.
1816	Compulsory vaccination law against Smallpox introduced.
1839	Journal Hygiea by the Swedish Medical Association; Smallpox re-vaccination recommended (not quite successful).
1842	Compulsory schooling introduced.

Table 11. *(continued)*	
Period/ Year	**Investment**
During the 1850s	The first statutes prohibiting child night work in industry introduced; legislations concerning the manufacture and sale of alcohol; trade unions, free churches, worker's political parties; construction of gutters in Malmö; the central canal of Malmö cleaned on several occasions; investments in cotton mills and soap manufacturing in Malmö; increasing imports of coal in Malmö; official campaings for better infant care intensified; significant increase in the number of midwives and doctors; Various Cholera epidemics → hospitals founded/isolation of the infected persons.
1852	A decision to widen and dredge Malmö's central canal.
1854-1859	Widening and dredging of Malmö's central canal (The central canal was cleaned and widened many times throughout the 19th century).
1858	Municipal Board of Health established in Malmö.
1860	Statistics Sweden.
1862	In urban areas the municipality becomes responsible for midwives, medical officers etc.
1868	Health regulation.
Early 1870s	Proposal for the construction of sewerage system in Malmö by M. Möller (failed to materialize because the City Building Committee concluded that it was a very expensive project. Instead, the central canal was widened again).
After 1870s	Water supply, construction of pipes, public pumps (in Sweden in general); Transformation of the drainage ditches into open gutters of dressed stone or glazed stone pipes by the Board of Health and private house owners (in Malmö).
1874	Public Health Act: every city or town has to establish a health care committee.
1877 or 1878	National Medical Board is founded; Chief Provincial Medical Officer appointed in every county.
During the 1880s	Privies gradually replaced by barrels in Malmö.
1882	Dysentery epidemic in Malmö. A special committee formed to investigate the causes of the epidemic; E. Heyman, the chairman of the committee, suggested a waste disposal plan through a sewerage system; Committee of Public Health appointed to study this proposal; proposal by engineer C. Ambt for a partly separate sewer system (mainly for wastewater and only a small amount of the rainwater).
1886	The city council of Malmö decided to postpone once again the construction of the sewerage system.
1887	First water closet in a hotel in Malmö.
1889	The Occupational Hazard Act comes into force; around that time in Malmö the Borough Finance Department decided to regulate private sewers.

Table 11. *(Continued)*	
Period/ Year	**Investment**
1890	Chief provincial doctor appointed in every county.
Beginning of the 1890s	Construction of water closets (in Malmö and Sweden in general).
1891	First sanatorium for lung disease sufferers is opened.
1895	The city council in Malmö ordered 1) the construction of cesspools for the disposal of solid waste by slaughterhouses, tanneries etc. 2) all sewers carrying unhealthy or toxic waste to be equipped with special filters; The city council forbade the use of water closets in Malmö.
1899	H. Holmberg instructed by the Borough Finance Department to design a sewerage system in Malmö.
Late 19th century	Home deliveries assisted by professional midwives; expansion of hospitals and mental institutions; philanthropic societies and voluntary associations for children and adults; expansion of voluntary health insurance societies; boom in the building industry→ housing conditions improved.
Early 20th century	Expansion of sanatoriums and Tuberculosis clinics; Expansion of Swedish midwifery services and introduction of antiseptic techniques during childbirth.
1902	Holmberg's plan presented in Malmö (his proposal did not include any wastewater treatment).
1904	National Institute of Medicine established; National anti-tuberculosis association is founded; New proposal by Holmberg for a sewerage system in Malmö (included a septic tank); After Holmberg's death, J. Gust Richert took responsibility for the project. However, not convinced by the benefits of a septic tank (he wanted to postpone the project).
1905	A revised proposal for the sewerage system in Malmö (accepted).
1905 onwards	All sales of liquor officially handled by government controlled companies.
1907	Institute of Bacteriology is established.
1908	Sewerage system in Malmö completed; the city council accepted the installation of water closets.
1912	National Board of Social Affairs established.
1913	A limited national basic pension for all is introduced.

Source: Author's choices based on data from: G. Fridlizius, 2002; J. Sundin and S. Willner, 2007; G. Olsson, 2007.