

Chapter 8

Decline in Infant Mortality: Japan's Historical Experience

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Abstract

Reducing the risk of infant mortality is one of the most important issues in developing countries. In today's developed countries, lowering the infant mortality rate was a major issue during the periods of economic development. Hence, reviewing studies that have analyzed the decline in infant mortality rates in developed countries can provide meaningful suggestions for developing countries. This study outlines the decline in infant mortality rates in Japan, and organizes and discusses the issues associated with the decline in infant mortality rates in other developed countries. Previous studies have focused on a number of factors that can be attributed to declining mortality rates, including studies on the effects of improvements in living standards, on private initiatives aimed at improving the hygiene of individuals and households, and on public health interventions. Recent studies tend to focus more on the third factor. In other words, they emphasize the effects of public and institutional interventions. However, multifarious factors are responsible for the decline in the risk of infant mortality in developed countries. Moreover, we must consider the synergistic effects of various public institutions and programs in the private sector. The most important point is to accurately clarify the questions surrounding the setups employed for the implementation of various interventions, the reasons institutions performed well in interventions, and the extent to which the system impacted infant mortality rates. I believe that accumulating such historical evidence is both a necessary and a valid means for providing meaningful suggestions to today's developing countries that are grappling with the issue of persistent, high infant mortality rates.

Keywords: Infant Mortality; Mortality

JEL Codes: N30, N35

I. Introduction

From the end of the nineteenth to the beginning of the twentieth centuries, European countries experienced a decline in infant mortality rates. For instance, at the end of the nineteenth century, the number of infant deaths per 1,000 births in England and Wales was 150. However, by around 1920, this figure had fallen to below 80 per 1,000 births (Hatton, 2011, pp. 960-964; Mitchell, 1988, pp. 58-59). In Japan, at the beginning of the twentieth century, infant mortality rates were higher than those in Europe. However, they continuously declined from the 1920s to the end of the World War II. The aim of this paper is to review studies that analyzed the historical factors attributed to the decline in infant mortality rates to gain meaningful suggestions and to apply them to the challenges developing countries presently face in reducing the risks associated with child mortality.

Economic development and health are closely interrelated. Amartya K. Sen (1999) asserts that we must focus on happiness that cannot be captured by real income alone; he implied that good health is one such important measure. Today, it has become a stylized fact that people's health greatly impacts the economy through its effect on the accumulation of human capital (*e.g.*, Bleakley, 2007; T. Paul Schultz, 2010). Furthermore, for the poorest nations, the improvement of conditions that promote and sustain health is deemed a necessary requirement for economic development (The Commission on Macroeconomics and Health, 2001). There has long been an interest, even in the field of history, regarding the relationship between the long-term development of these types of economies and health. Thomas McKeown (1976, 1979) states that the essential factors for the improvement of a population's health, from the eighteenth century, were economic development and better nutrition. He concludes that the principal factors for the decrease in mortality rates were improved living standards and increased nourishment, in particular. Based on the claims of McKeown, Robert W. Fogel compiled research on historical experiences related to health and the economy.¹ Fogel (1997, 2004) emphasized that improvements in nutritional status reduced mortality rates in Western Europe throughout the nineteenth and twentieth centuries.

Contrary to previous studies that focused on such improvements in nutrition, in recent years, it has been revealed that other public health measures, such as the development of water and sewerage systems, also contributed to the decrease in mortality rates from the nineteenth to the twentieth centuries (Deaton, 2006, p. 110). For instance, Szreter (1988) pointed out that systematic governmental interventions in public health were major determining factors in

¹ For more details on McKeown and Fogel's discussions, see Deaton (2006).

mitigating mortality (see also Brown, 1989; Cutler and Miller, 2005). More recently, it has also been revealed that national health insurance systems, which expanded between the end of the nineteenth and the beginning of the twentieth centuries, contributed to reductions in mortality risk. Using the panel data of five European countries across the end of the nineteenth and the beginning of the twentieth centuries, Winegarden and Murray (1998, 2004) concluded that the expanding coverage of government-sponsored health-insurance programs across the population contributed to the declines in overall mortality. Furthermore, Bowblis (2010) used data for eleven European countries for the period 1878–1913 and revealed that maternity benefits, supplemental income to new mothers, and proper infant care practices provided by health insurance also reduced the infant mortality rate.

This paper has two goals. First, I provide an overview of the historical transition in infant mortality in prewar Japan. Second, I discuss the main hypotheses that are current in the relevant economics literature. The reasons for setting such goals are as follows: Target 4–A of the United Nations’ millennium goals (MDGs: Millennium Development Goals) aim to reduce the mortality rate for children below the age of five to one-third of the 1990 levels by 2015 (United Nations, 2005). Reducing the risk of infant mortality is a challenge faced by many developing countries. While Japan’s infant mortality rate in prewar times was equal to or higher than today’s developing countries, a continuous decline in the infant mortality rate was observed from the 1920s to the 1930s. It has long been advocated that gaining knowledge from such historical experiences as Japan’s could help reduce the risk of child mortality in developing countries. For example, in its report, “The Issues of Public Health and Medical Systems in Developing Countries,” the Japan International Cooperation Agency (JICA) surveyed the various measures related to Japan’s health and medical systems throughout its history. The report states, “In international forums Japan has announced its intention to utilize its experience in cooperating with developing countries. What has hitherto been lacking, however, is a systematic analysis to determine what aspects of Japan’s experience will be useful, and what areas require caution in applying Japan’s experiences to developing countries,” (JICA 2004, p.5-6). Therefore, reviewing studies that have analyzed the historical factors that led to the decline in infant mortality rates provides an opportunity to gain various meaningful suggestions regarding policies that aim to decrease the risk of child mortality, which is a critical issue faced by today’s developing countries (*e.g.*, Gamper–Rabindran et. al, 2010).

Based on an understanding of the above issues, this paper highlights the issues related to infant mortality in prewar Japan, and discusses some recent studies on the historical experiences of infant mortality in other countries. Through this process, the ultimate goal of this paper is to provide meaningful suggestions for today’s developing countries in dealing with this critical

issue. However, because there is an extensive amount of research regarding mortality risk in fields other than economics, such as medicine and epidemiology, this study will limit its discussion to accord with its abovementioned goals. First, this paper will focus on infant mortality in children less than one year old. Accordingly, deaths of infants older than one and of adults are excluded from the discussion, and references to them will be only as they relate to previous studies. Second, as its main purpose is to gain suggestions for development research, this study looks back on the historical experiences of Japan. Therefore, studies on infant mortality in Japan after World War II will be confined to the extent of a partial discussion. Although the subject of the discussion is limited, in terms of its findings, this paper is the first among the studies on infant mortality in Japan to provide suggestions for development research through a review of Japan's relevant economic history.

The discussion is organized into four sections. Section 2 briefly describes the historical transition and knowledge of the secular decline in infant mortality in Japan. It also alludes to comparisons with the historical experiences of advanced countries. In Section 3, I review previous studies that have analyzed the factors attributed to the decline in mortality and infant mortality rates in developed countries and discuss their trends. Section 4 draws conclusions.

II. An overview of infant mortality in modern Japan

This section provides an overview of the characteristics of the changes in infant mortality rates, over time, in Japan. In this paper, the infant mortality rate is defined as the number of infant deaths per 1,000 live births. Furthermore, the neonatal mortality rate is defined as the number of infant deaths within 28 days of birth per 1,000 live births; postneonatal mortality rate is defined as the number of deaths in infants aged 28 days to one year per 1,000 live births.

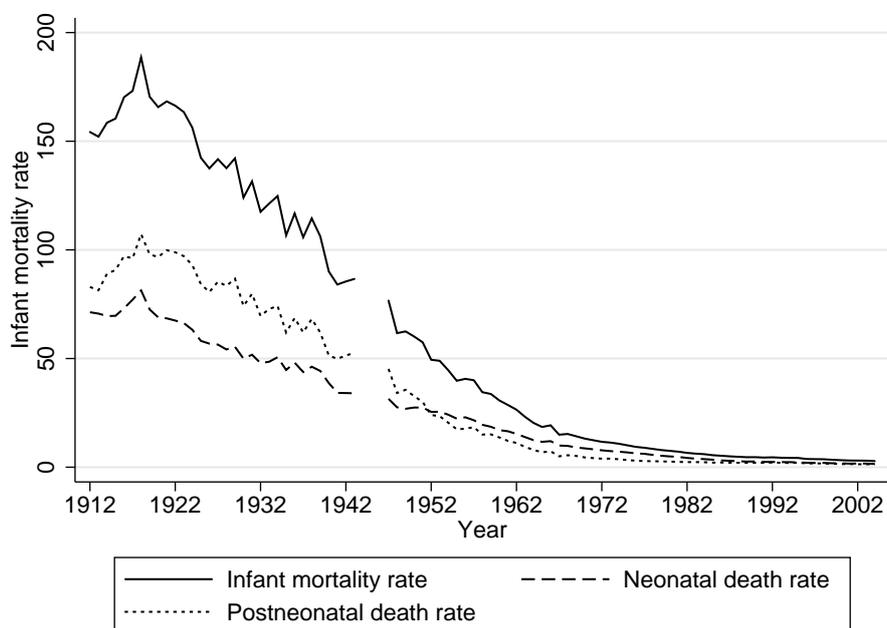
1. Historical transition of infant mortality

Here, I present the long-term trends in infant mortality in Japan. **Figure 1** shows the trends in infant mortality rates in Japan from 1912 (the beginning of the Taisho period) to the 2000s.

First, I explain what occurred in the period prior to the phase of decline.² According to Figure 1, infant mortality rates exhibited a rising trend during the Taisho period, peaking in 1918 during the influenza pandemic. In fact, while infant mortality rates decreased in Western countries from the end of the nineteenth century, they increased during the Taisho period in

² Here, attention is focused on the changes in the infant mortality rate in the post-Taisho Era. For child mortality rates from the Tokugawa to the Meiji eras, refer to the review by Saito (2001 pp. 73-75).

Figure 1: Infant mortality rate in Japan



Note: Infant mortality rate is the number of deaths of infants under one year old per 1,000 live births. Neonatal death rate is the number of neonates dying before reaching 28 days of age per 1,000 live births. Postneonatal death rate is the number of infants dying at 28 to 365 days of age per 1,000 live births. Data from 1944 to 1946 were omitted due to incompleteness. Source: Statistics Bureau of the Cabinet (various years), Ministry of Health and Welfare (various years).

Japan, widening the gap of relative disparity in infant mortality rates between Japan and the West. Johansson and Mosk (1987) noted that the reason for this was a government that was striving to become a military power while neglecting to invest in public health measures effective in combating infectious diseases. In regards to these trends, Saito (2001, p.83) explained, “Behind the facts that mortality rates of postneonatal infants and of 1-year-olds rose from the Meiji period to the Taisho period, lies the increased movement of people due to a rise in economic activity; in other words, Japan’s westernization (*bunmeikaika*) increased the frequency of people’s contact with pathogens.”

However, Japan’s infant mortality rates began to decline in the mid-1920s at the start of the interwar period. Using Japan’s vital statistics for every 5 years, Saito calculated the infant mortality rate by prefecture and investigated the periods that recorded a decline of more than 10% from the previous year. The results showed that from 1925 to 1929, 32 of 46 prefectures experienced declines of less than 10%. This implies that two-thirds of the 46 prefectures showed

declines in infant mortality during the 1920s. In the Tohoku region, where the level of infant mortality was high, despite rural areas being stricken by poverty during the Showa Depression, mortality rates significantly declined in all prefectures in the region during the 1920s. It should be noted that 11 of the remaining 14 prefectures where such declines were not observed were located in the regions west of Kansai. Mortality rates have always been lower in the Western Japan region; thus, while the declines were smaller, the mortality rates were also low. From the above observations, he concluded that infant mortality rates began declining in 1925 on a “social-wide scale.” In the future, more detailed analysis of these conclusions is required. However, when looking at the national level, it is clear that Japan’s infant mortality rate began declining at the beginning of the interwar period.

As seen in Figure 1, the decline in infant mortality rates was continuous in post-World War II Japan. The infant mortality rate was 77‰ in 1947, 40‰ in 1950, and fell below 20‰ in 1965. Considering the fact that the infant mortality rates in the United Kingdom and the United States were 20‰ between 1950 and 1955, Japan was able to reduce its infant mortality rates to the level of developed countries after 10 years of its defeat in the war (Saito 2001, p.82).

2. Components of and regional differences in infant mortality

To understand the context of the trends in infant mortality in Japan, the trends in neonatal and postneonatal mortality are also displayed in Figure 1. Thus, it can be seen that, until the early 1950s, postneonatal deaths outnumbered neonatal deaths, which was reversed after the 1950s. **Figure 2** shows the change in the percentage of postneonatal deaths in relation to overall infant deaths. As observed, the prewar postneonatal mortality rate was 50% higher than that in the postwar period. In addition, we can see that it was 60% higher than the postwar rate for some years in the 1930s. In short, during the prewar period, there was a greater likelihood of postneonatal deaths, with the number of early infant deaths occurring within one month of birth being relatively small. Regarding this trend, Saito (2001, p.83) suggested that after birth, infants got antibodies from sources such as breast milk, which offered a high level of protection against infections and diseases. However, after one month, the efficacy wore off and an increase in mortality rates resulted from contact with pathogens until the age of about 18 months.

The gap between such postneonatal mortality rates and neonatal mortality rates started decreasing from the 1920s to the 1930s. In other words, as seen in Figure 1, not only were neonatal mortality rates declining but postneonatal mortality rates were also declining during the interwar period; however, the rate of the decline of postneonatal mortality was greater, on average. Consequently, after the war, around the end of the 1940s, the gap between postneonatal and neonatal mortality rates closed completely. As we can see in Figure 2, the proportion of

Figure 2: Proportion of postneonatal deaths (%)

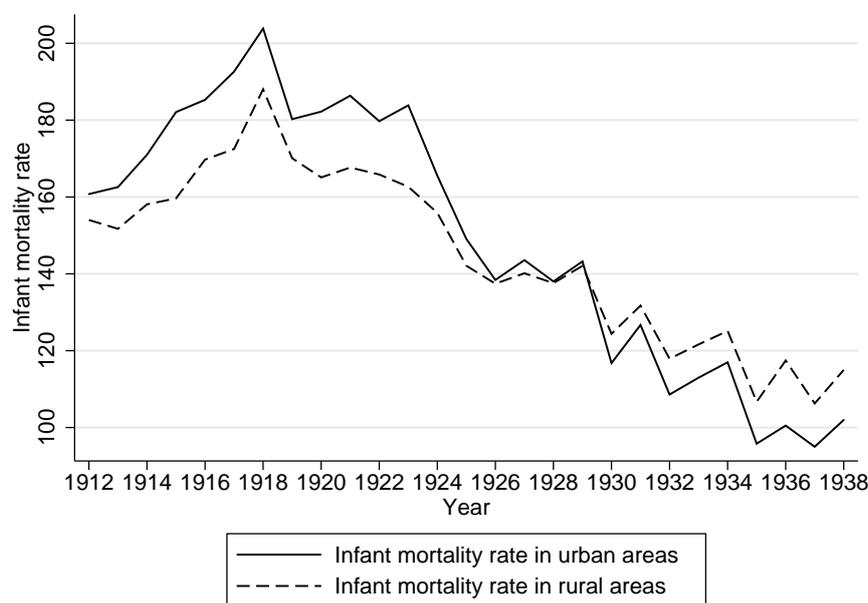


Note: Solid line shows the proportion of postneonatal deaths to the infant deaths (%). Data from 1944 to 1946 were omitted due to incompleteness. Source: Statistics Bureau of the Cabinet (various years), Ministry of Health and Welfare (various years).

postneonatal mortality to infant mortality, on a whole, was 50% around 1950 and rapidly decreased to less than 30% by the early 1970s. Thus, in regards to the decline in infant mortality from the postwar period to around 1970, in relative terms, the improvements in postneonatal mortality risk are more apparent than the improvements in the risk of neonatal mortality. In addition, Figure 2 clearly shows an opposite trend from the 1980s, where the proportion of postneonatal mortality rises once again as opposed to all cases of infant mortality. As exhibited in Figure 1, the decline in postneonatal mortality rates slowed during this period, which increased the relative rate of decline in neonatal mortality. In the 1990s, postneonatal mortality rates returned to less than 50% of the neonatal mortality, and we see a slight trend in which the proportion of neonatal deaths outnumbered that of postneonatal deaths (Figure 2).

Now, I would discuss the regional differences in the improvements in infant mortality rates—specifically regarding the difference in the decline between urban and rural areas—during the prewar period. **Figure 3** depicts the trends in the infant mortality rates from 1912 to 1938 between urban, i.e., Tokyo, Kanagawa, Aichi, Kyoto, Osaka, Hyogo, the six prefectures containing major metropolises, and rural, i.e., the remaining 41 prefectures. From the figure, before declining, infant mortality rates were higher in urban than in rural areas.

Figure 3: Infant mortality rate in prewar Japan



Note: Urban areas include Tokyo, Kanagawa, Aichi, Kyoto, Osaka, and Hyogo prefectures. Rural areas include the other prefectures. Source: Statistics Bureau of the Cabinet (various years), Ministry of Health and Welfare (various years).

However, as mentioned above, in the 1920s, infant mortality rates had already begun to decline nationwide in both urban and rural areas. The gap between urban and rural areas closed in the mid-1920s. In the 1930s, mortality rates in urban areas were less than those in rural areas. In other words, when comparing urban and rural areas, the speed of decline in infant mortality rates in urban areas exceeded that of rural areas.

It must be noted that the infant mortality rates for the cities of Tokyo, Yokohama, Nagoya, Kyoto, Osaka, and Kobe also include the rural areas located in the vicinities of these cities (Figure 3). Thus, to more accurately analyze the differences between the trends of infant mortality rates in urban and rural areas, it is necessary to calculate and compare the infant mortality rates in the urban areas of these six major metropolises. However, the abovementioned results agree with the results of existing research regarding the trends of infant mortality in urban and rural areas (see Ito, 1998, pp. 3-5). Ito (1998, p.5) pointed out that these regional differences may arise because improvements in the living conditions of pregnant women, that reduce neonatal mortality risks, first occur in urban areas and subsequently spread to rural areas. He further went on to mention the decline in postneonatal mortality rates observed above. He suggested that the reduction in neonatal mortality risk was mainly because of improvements in

the living conditions of infants, which possibly occurred in urban areas.

3. Causes of the infant mortality

Now, I present an overview of the characteristics of the causes of infant deaths in prewar Japan and the trends associated with them. The factors in infant mortality differed between neonatal and postneonatal deaths. In general, deaths due to congenital diseases and syphilis were pervasive in the neonatal period. In the postneonatal period, deaths due to respiratory diseases, digestive system diseases, beriberi, and meningitis were common. In other words, there was a strong tendency for congenital diseases to be a cause of deaths in the neonatal period and for acquired diseases to cause deaths during the postneonatal period (Ito 1998, p.6).

Table 1 shows the proportion of these causes of deaths per 1,000 live births. As previously mentioned, mortality rates increased from the 1900s to around 1920, and then decreased throughout the 1930s. First, we will review the trends in the two main congenital causes of death in the neonatal period. According to the national average, congenital diseases rose during the 1908–1922 period and decreased throughout the 1930s. In addition, mortality rates due to syphilis declined consistently. Furthermore, we observed that mortality rates due to congenital factors consistently declined in urban areas. However, we should note that premature births due

Table 1: Causes of Infant Mortality (‰)

	Total			Urban areas		
	1908	1922	1930	1908	1922	1930
Total	36.2	40.8	37.7	38.6	34.9	34
Congenital diseases	32.9	38.1	36	34.7	32	32
Syphilis	3.3	2.7	1.7	3.9	2.9	2
Total	71.5	85.6	64.5	104	112	65
Respiratory diseases	33.9	34.9	25.1	42.1	36.7	24
Digestive system diseases	17.5	33.1	28.5	26.4	42	27
Beriberi	1.6	4.2	3.8	10.7	14.9	7.6
Meningitis	18.5	13.4	7.1	24.9	17.9	6.7
Cause of death unknown	21.9	17.6	6.1	20.7	13.5	3.7

Notes: All figures represent the number of infant deaths per 1,000 live births. Respiratory diseases refer to chronic bronchitis, pneumonia, and other respiratory diseases. Digestive system diseases refer to diseases of the stomach, diarrhea, and enteritis. Congenital diseases refer to malformations, congenital disabilities, and diseases specific to infants. *Source*: Ito, 1998, Table.3.

to congenital diseases were common. Regarding the statistics on the causes of death, Ito (1998, p.7-8) noted the following three factors: (1) diagnoses upon death were often incorrect; (2) causes of death were often unknown during the Meiji and Taisho periods; and (3) premature births were often reported as stillbirths during the Meiji period. Because of factor (3), the mortality rates from congenital diseases during 1908 may have been underestimated, leading to doubts over the data that shows a rise in mortality rates due to congenital diseases in the national average from 1908 to 1922 (Ito 1998, p.8). In any case, the change in the 1908–1930 mortality rates due to congenital diseases and syphilis is not very significant, i.e., 1.5‰ (37.7–36.2) for the nation and 4.8‰ (33.8–38.6) for the urban areas.

Second, I review the trends in the four acquired diseases that are the leading causes of postneonatal deaths. Nationally, the mortality rates for digestive system diseases and beriberi increased from 1908 to 1922.³ The years 1922–1930 saw a decline in all causes of death. The largest to the smallest percentages of decline were as follows: respiratory diseases (–9.8), meningitis (–6.3), digestive system diseases (–4.6), and beriberi (–0.4). The percentages of the declines in urban areas for the same period were: digestive system diseases (–15.5), respiratory diseases (–12.3), meningitis (–11.2), and beriberi (–7.3). From 1908–1930, changes in mortality rates were greater in comparison to deaths due to congenital factors: –7‰ (i.e., 64.5–71.5) nationally and –38.9‰ (i.e., 65.2–104.1) in urban areas. When examining the decline that occurred during 1922–1930, declines in deaths due to acquired diseases were recorded as –21.1‰ (i.e., 64.5–85.6) nationally and –46.3‰ (i.e., 111.5–65.2) in urban areas. Because of the significant decline in such causes of death, it is considered that improved treatments for acquired diseases considerably contributed to improvements in infant mortality rates in the cities (Ito 1998, p.7). However, as we draw inferences regarding the changes in mortality rates based on these causes of death, the nationwide decline in postneonatal mortality rates can be attributed to improvements in the treatment and prevention of acquired diseases that played a significant role in reducing infant mortality rates.

4. International comparison of developed countries

Finally, I will compare the changes in infant mortality rates in Japan and Western countries. **Table 2** presents the trends in infant mortality rates from the end of the nineteenth to the mid-twentieth centuries for Japan, the United Kingdom (England and Wales), France, Germany,

³ Ito (1998) claimed that a factor for the rise in mortality rate due to beriberi was the spread of a diet based on white rice due to urbanization (p.13). In addition, the main respiratory disease was pneumonia. However, because reason (3) is associated with the statistics on causes of death mentioned above and because pneumonia was classified under a different condition, trends in mortality rates due to respiratory diseases from 1908–1922 remain unclear (p.7).

Table 2: Transition of infant mortality in developed countries (‰)

	Japan	England and Wales	France	Germany	Italy	Sweden
1871-1880	-	149	172	261	215	130
1881-1890	-	142	166	227	195	111
1891-1900	150	154	164	221	176	102
1901-1905	152	138	139	199	167	91
1906-1910	158	117	126	174	152	78
1911-1915	157	110	121	160	140	72
1916-1920	174	91	128	145	155	67
1921-1925	159	76	100	122	125	60
1926-1930	137	68	94	115	120	58
1931-1935	121	62	77	81	105	50
1936-1940	107	56	74	65	103	42

Notes: Infant mortality rates are expressed as the mean values of each period. Source: Ito, 1998, Table.1

Italy, and Sweden.

Between 1891 and 1900, Japan's infant mortality rate was relatively low compared to these Western countries. However, as infant mortality rates in Western European countries continuously declined from the end of the nineteenth century, far from remaining unchanged until around 1920, Japan's infant mortality rate displayed a rising trend. While Japan's infant mortality rate began to decline around the mid-1920s, by 1921-1925, the United Kingdom had already declined to 76, France to 100, Germany to 122, Italy to 125, and Sweden to 60 deaths per 1,000 births. During the 1920s, Japan's infant mortality rate was much higher than these Western European countries.

A key feature of the decline in Japan's infant mortality rate was its speed (Ito 1998, p.2-3). While in the United Kingdom, France, and Italy, it took 20 years for infant mortality rates to decrease from 150 to 100 deaths per 1,000 births (see Table 2), Japan progressed at the same pace as Germany and accomplished the same reduction in less than 20 years. In other words, a characteristic of the decline in prewar Japan's infant mortality rate was that it started later, in comparison to contemporary developed countries, but occurred at a faster rate.

III. Explanations and Evidences

Mortality rates in Western Europe dropped dramatically during the nineteenth and twentieth

centuries, which has been well documented, and related research has been accumulated for a long time. McKeown (1976) claimed that improvements in the quantity and quality of the daily dietary intake contributed to the decline in mortality rates instead of medical intervention (see also Collins 1982; Fogel 1994).⁴ In addition, the efficacy of the actions of individuals and households in terms of improving hygiene has also been reported (Ewbank and Preston, 1990). Other factors are health behavior campaigns that were conducted from the late nineteenth to the first half of the twentieth centuries, which promoted hand washing, milk pasteurization, and breast feeding (see Deaton and Paxton, 2001; Elo and Preston, 1996; Lleras-Muney, 2002). Furthermore, much research has emphasized the efficacy of public health interventions.⁵ Szreter (1988) criticized McKeown's understanding of the trends in deaths attributable to disease as well as his handling of data on respiratory diseases for which public health interventions would likely be effective. Moreover, epidemiological studies focusing on trends in mortality factors were conducted (Omran, 1971). According to Caldwell (2001), the reduction of infectious diseases in early youth increased the proportion of deaths due to chronic diseases in a relatively older population. This suggests that increased access to medical care may have contributed to the decline in mortality rates.

Omran, Winegarden, and Murray (2004) analyzed the impact of government-sponsored health-insurance programs on the decline of mortality rates. Using data from five European countries during 1875–1913, they found that mortality rates decline as the percentage of the population covered by health insurance increases (see also Winegarden and Murray, 1998). This result is in line with previous studies suggesting that the lower mortality rates were due to an increase in the number of physicians (Mackenbach, 1996; Mokyr and Stein, 1997). In addition, while Winegarden and Murray analyzed the impacts of health insurance systems on the crude mortality rate, it was Bowblis (2010) who explicitly analyzed its impacts on infant mortality rates. By utilizing the panel data of 11 European countries for the years 1878–1913, he revealed that confinement maternity benefits and parental leave in early health insurance programs led to

⁴ Breschi, Fornasin, Manfredini, Mazzoni, and Pozzi (2011) analyzed the impact of socioeconomic conditions on health and mortality between birth and adulthood, within the Sardinian community of Alghero using the data from civil registers and military conscription lists for the period 1866–1925. In addition, Nunn and Qian (2011) revealed that increase in population and urbanization observed in the eighteenth–nineteenth centuries were a result of potatoes being transplanted from the New World to the Old World, based on a difference-in-difference model using the period of potato introduction and potato suitability as indicators.

⁵ For a criticism of the works of McKeown and Fogel, who claimed that a decline in mortality rates was a result of improvements in living standards, see Preston (1996). In addition, for a study analyzing the causal effects of fertility transition on the decline in infant mortality, see Fernihough and McGovern (2014). They used micro level data collected from 13 German villages covering the 16–nineteenth century, and found that there was little evidence to support the hypothesis that fertility transitions influenced declines in infant mortality.

a decline in infant mortality rates. In addition, he concluded that 18–35% of the total decline in crude mortality rates during this period was attributable to a decline in infant mortality rates resulting from health insurance. Hatton (2011) suggested that improvements in the disease environment through such declines in infant mortality rates may have added to the average height of children in the United Kingdom during the first half of the twentieth century.

Similar to European countries, the United States experienced a decline in infant mortality rates from the end of the nineteenth to the early twentieth centuries.⁶ Mortality rates dropped to 40% from 1900 to 1940, equating to a decline of 1% per year. During this period, life expectancy at the time of birth increased from 47 to 63 years. The main factor for this was the decrease in the number of deaths attributed to infectious diseases (Culter and Miller 2005, p.1). Culter and Miller (2005) analyzed the impact of the filtration and chlorination of tap water on these declines in mortality rates. The results indicated that, in major cities, during the years 1900–1936, approximately half of the decline in mortality rates, approximately four-thirds of the decline in infant mortality rates, and approximately three-half of the decline in child mortality rates were attributed to increased access to clean water. They claimed that clean water technologies were possibly the most important public health intervention of the twentieth century (p.2). Furthermore, Ferrie and Troesken (2008), focusing on the decline in mortality rates in Chicago during 1850–1925, revealed that 30–50% of the decline was due to the improvement in water quality⁷.

Researchers also analyzed the impact of government expenditures on the decline of mortality rates. Miller (2008) claimed that increase in state and local public health and education expenditures, upon the enactment of women's suffrage, curtailed deaths due to infectious diseases during 1900–1936 (see also Fox 2011). However, some studies have indicated the effect of public health expenditures as being small in current developing countries. For example, in response to studies claiming that public health expenditures have a significant impact on the decline of infant mortality (Anand and Ravallion 1993; Anyanwu and Erhijakpor 2009; Gupta et al 2002; Hojman 1996), some studies have claimed that these effects are insignificant (Aiyer et al 1995; Filmer et al 1998; Filmer and Pritchett 1997; Kim and Moody 1992; McGuire et al 1993; Musgrave 1996). Moehling and Thomasson (2014) pointed out that the differences in the efficacy of public health expenditures among these studies, until now, are due to the fact that the data used in the analysis included expenditures for both effective and ineffective programs. Among the Sheppard–Towner programs that were introduced during 1924–1929, programs

⁶ Using the infant mortality rate and the change in infant mortality rate, there was a 20th-century inequality trend in the United States to those that were traced (Haines 2011).

⁷ See also Evans (1987), Victoria (1988), Fildes (1992), and Reid (2002) for details on the relationship between nursing and water quality.

based on one-on-one contact and follow-up care, such as home visits by nurses and establishment of health clinics, proved more effective than classes and conferences. Furthermore, they claimed that the efficacy of these programs was particularly significant for nonwhites, who generally had restricted access to medical care.

Finally, although less than the studies on Europe and the United States, the question of why the infant mortality rate in Japan declined has attracted research interest (*e.g.*, Mouri 1972; Saito 1992). I will introduce works that analyzed the causes of the decline of infant mortality rates in prewar Japan. It is considered that the government's countermeasures against rising infant mortality and the increase in the number of childcare institutions reduced the infant mortality rate in the early stages (Ito 1998). In 1916, to implement countermeasures to infant mortality, the Ministry of Interior established an investigative committee on hygiene as an advisory body.⁸ In 1920, the Health and Hygiene Committee's resolutions were summarized in a "Matter on the Advancement of Child and Maternal Insurance." The following details were included: (1) placing hospitals in cities to accommodate poor expectant and nursing mothers. Maternity hospitals should have midwife and nurse stations annexed to them for providing nursing services for expectant and nursing mothers when hospitals are over capacity; (2) establishing childcare consultation offices in cities to accommodate childcare consultations and health checkups; (3) establishing infant nurseries in cities to provide free or paid-for accommodations for infants who are difficult to care for; (4) establishing public midwife practices in areas that do not have one; and (5) facilitating the spread of the concept of health and hygiene by planning children's weeks and children's hygiene exhibitions. In 1920, the Ministry of Interior launched educational programs in accordance with this policy (Ito 1998, p.14). First, exhibitions on children's hygiene were held, followed by lectures, physical examinations, and advertising campaigns on the streets. In the following year, manuals were published and lectures were organized for social service workers, day-care workers, midwives, nurses, and teachers. In 1925, the Health and Hygiene Committee published "Guidelines for Pediatric Health Centers" and began pediatric welfare programs such as health consultations, home visits, and the provision of milk. By 1938, 260 child health consultation offices were established; however, the provision of milk did not proceed as planned due to budget constraints (Ito 1998, p.15–16). In response to such measures by the Ministry of Interior, local governments developed their own programs with the support of the Ministry; in 1921, child hygiene exhibitions were conducted in 28 cities.

⁸ It should also be noted that the Social Relief Works Committee was established in the Ministry of Interior's Department of Social Affairs in 1918, and was reorganized by the Social Works Committee in 1921. Discussions of social work regarding child protection and maternal protection were also conducted by this committee. Higami *et al.* (2013) reviewed the characteristics of infant mortality in Osaka as well as various policies designed to combat the infant mortality problem.

Ito pointed out that with the spread of awareness programs and facilities, such as child health consultation offices, the importance of breast-feeding was recognized primarily as a result of promoting the dissemination of knowledge on nutrition, which may have contributed to a decline in infant mortality rates, mainly in urban areas (Ito 1998, p.18). However, when considering public health expenditures, as previously mentioned, direct intervention, such as the establishment of health clinics and home visits by nurses, proved more effective rather than classes and conferences (Moehling and Thomasson, 2014). Thus, if the programs by the Ministry of Interior significantly lowered infant mortality rates, we must demonstrate which programs, in particular, were effective.

In addition, Ito stated that the increased number of midwives contributed to the decline in infant mortality rates in rural areas in the 1920s.⁹ Saito (2008a, 2008b) focused on the activities of midwives and the decline in the risk of infant mortality since 1930, and analyzed the efficacy of the Aiiku-kai's Aiiku-son project. The Aiiku-kai was established to improve mother-child hygiene in rural communities. Its core program, the Aiiku-son project, began in 1936. The Aiiku-son project designated villages with high infant mortality rates and developed a system of home visits by midwives and other services, with the goal of lowering the infant mortality rate of the entire village. In 1936, there were five designated villages; in 1937, there were four; and in 1938, there were three. The Aiiku-son project was subsequently incorporated into the Ministry of Welfare's Social Affairs bureau and saw a dramatic rise in designated villages under the wartime regime (Saito 2008a, p.39-41). Saito compared infant mortality before and after Aiiku-son and found that decline in infant mortality rates was greater in Aiiku-son-designated villages than in non-designated villages. However, he stated that the Aiiku-son designation, in and of itself, did not induce the decline in the infant mortality rates for those villages (2008a, p.52). It is likely that the home visits made during the Aiiku-son project reduced the risk of infant mortality because there were direct interventions with expectant and nursing mothers (e.g., Moehling and Thomasson 2014). However, as previously mentioned, the designation of Aiiku-son became widespread from 1939 when the infant mortality rates had already reached a prewar low (**Figure3**). Thus, one cannot help but state that the impact of the Aiiku-son project on lowering infant mortality rates in the 1930s was limited nationally.

More recently, Ogasawara and Kobayashi (2015) focused on the impact of social workers, the Homen-iin, on reducing infant mortality in interwar Tokyo. They revealed that the medical

⁹ Miyamoto (2014) also suggested the significance of the contribution of midwives in a case study of Shimane prefecture. In addition, Shirai (2007), studied rural areas and pointed out that increased agricultural productivity was a result of the drained-field, horse-and-plow agricultural method introduced during the Meiji Period, that this changed the household labor distribution, and that it may have led to improvements in the health of women from farming families.

casework conducted by these social workers played a vital role in mitigating the risk of infant mortality rather than the activities of midwives, especially in areas with higher infant mortality rates. Social workers were volunteers who worked for the Tokyo District Committee System. They identified potentially poor households within communities using social surveys, and through regular household visits referred the household's expectant or nursing mothers and/or their infants to medical institutions when necessary. From historical analysis, it was found that infants from poor households who received medical treatment through the work of a social worker were able to recover from their illnesses. In addition, social welfare commissioners conducted information campaigns, such as distributing pamphlets on childcare, and it was also revealed that they contributed toward spreading knowledge on hygiene and sanitation. Previous research on infant mortality rates in Japan did not utilize econometric models that could identify the causal effects of interesting policies. Using the quantile regression approach that addresses endogeneity, Ogasawara and Kobayashi measured the causal effect of casework performed by social workers. The results indicated that the activities of social workers significantly lowered infant mortality rates. Moreover, this effect was particularly large in regions with high infant mortality rates. This shows that programs that offered direct interventions with households are effective and measures aimed toward groups with restricted access to medical care are particularly effective; this result that is consistent with recent studies (Moehling and Thomasson, 2014).

As is apparent from the above review, when considering the attributes of declines in infant mortality or mortality rates, it is important to note that mortality rates cannot be explained by only one factor. For example, while Winegarden and Murray emphasized the role of health insurance in the decline of mortality rates, the efficacy of improvements in nutrition levels and public health interventions, as pointed out by McKeown and Szreter, are also believed to have contributed to the decline of mortality rates in Europe (p. 1828). In other words, while deepening the discussion regarding the change in living standards and various institutional interventions is important, we must consider the plurality of factors related to the decline of historical mortality risks (*e.g.*, Culter and Miller, 2005, p.2). For today's developing countries aiming to lower their infant mortality risks to gain meaningful suggestions, we should continue to elucidate the details and efficacy of the various public interventions and private programs performed in developed countries.

IV. Conclusion

Lowering the risk of infant mortality is one of the challenges faced by several developing countries. According to target 4-A set by the United Nations MDGs, the goal is to reduce the mortality rates for children below the age of 5 years to one-third of the 1990 level by 2015. Today's developed countries experienced declines in infant mortality rates during the course of their economic development. Japan's prewar infant mortality rates were the same, if not higher, than the levels of today's developing countries, however, they experienced a continuous decline from the 1920s through the 1930s. In the past, the importance of applying historical experiences of such developed countries has been emphasized (*e.g.*, JICA 2004). Many meaningful suggestions can be offered to developing countries by reviewing studies that have focused on the decline in infant mortality rates in developed countries and the factors attributed to these declines.

Based on an awareness of these issues, the author has presented the factors related to infant mortality in prewar Japan. In addition, the research on the decline in infant mortality rates in Western European countries and the United States is discussed along with the studies that focused on the factors responsible for the decline of Japan's infant mortality rates. These previous studies are roughly divided into three issues: improvements in living standards; the efficacy of improvements in individual and household hygiene; and the efficacy of public health interventions. Considering studies conducted on prewar Japan, several studies indicated the efficacy of the Ministry of Interior's infant protection programs of the 1920s (mainly occurring in urban areas), as well as the impacts of improvements in the quantity and quality of midwives in rural districts. In recent years, research has also pointed out the benefits of social work in urban areas. As is apparent from the reviews, there has been an increase in studies emphasizing the third point of discussion, namely, the effects of public and institutional interventions on the decline in infant mortality rates.

While deepening the discussion on the impact of changes in living standards and the various institutional interventions is important, it is also important to consider the plurality of factors related to the decline in mortality risks observed throughout history. As emphasized by Culter and Miller (2005), it is important to remember that there is more than one attribute in the decline in the risk of infant mortality. In reality, the synergistic effects of various public institutions or private programs lead to the continuous decline of infant mortality rates. Thus, the most important point is to accurately clarify the questions surrounding the mechanisms through which the various interventions were implemented, the reasons the institutions related to these interventions performed well, and the extent to which the system impacts infant

mortality rates. I believe that accumulating such historical evidence is both a necessary process and a legitimate means for providing meaningful suggestions to today's developing nations in their quest to further reduce infant mortality rates.

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