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mortality rates. Milk depots in Spain (1900-
1936)**

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Health intervention and decline in infant mortality rates. Milk depots in Spain (1900-1936)¹

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Abstract

The role of public health has been a central topic on the classical debate about the historical mortality decline in Europe. One of these health initiatives were the Milk Depots. Spain set up those centres from the late 19th century until the beginning of the Civil War. The goal of this paper is to evaluate the effect of this health intervention on the infant mortality decline during this period. This study works out three kinds of sources: Statistical Yearbooks, Official documents and local records produced by the same Milk Depot. It analyses data available for all the country and one local case such as the Barcelona's Milk Depot (1904-1935). The main methodological issue deals with the measurement of the effect of the Milk Depot activities on the pattern of changes of infant mortality. Results suggest that Milk Depots have a positive but quite moderate effect on the improving of overall levels of child survival.

1. Introduction

In many European societies during the last two decades of the 19th century, there was deep concern about levels and trends in infant mortality. There was no evidence to suggest that infant mortality might start an irreversible decline throughout the first decades of the 20th century. Fighting against infant mortality was a national priority in the most advanced nations. The improvement of children's welfare was the main goal of two kinds of policies. On the one hand, policies on legal issues, such as the status of births outside of wedlock, and working conditions for mothers and children. On the other hand, health policies promoted a variety of interventions, for example, compulsory vaccination and health inspections at schools.

Around the end of the 19th century, one topic was emerging as a core issue in the diagnosis of the health status of children, the feeding methods for the newborn and infant population during their first two years. Because digestive system illnesses were stressed as a main cause of death, "the question of milk became a central concern in the fight against infant mortality" (Rollet, 1995).

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An exchange of diagnostic criteria and therapies about how to improve child nutrition involved the first generations of physicians specialized in “Pediatrics” in countries with different infant mortality levels and different medical cultures. One of the main practical effects of these discussions was the implementation of a health intervention aimed at improving feeding practices. It is well known that the creation of Milk Depots, or “Gouttes de Lait” in French, was the means chosen to achieve this goal. However, this initiative went beyond national level when an international movement was promoted. Three international conferences, 1905 (Paris), 1907 (Brussels) and 1911 (Berlin) were held to share experiences and propose new goals. However, the political and social traditions of each country shaped the various styles of Milk Depots. French or Anglo-American approaches emerged as two different ways of managing this health intervention. The Spanish way of organizing the Milk Depots was very close to that of the French. Spanish doctors kept in touch with their French colleagues and were aware of their health initiatives from the very beginning. Thus, from the point of view of their medical goals and management style, Spanish Milk Depots (“Gotas de Leche”, in Spanish) follow French guidelines.

The goal of this study is to evaluate the effect of this health intervention on the infant mortality decline before the Spanish Civil War. Researchers investigating this topic have studied Milk Depots in several Spanish localities (Madrid (Majan, 1990), Alicante (Perdiguero-Gil and Bernabeu-Mestre, 1999, 2005) Gijon (Chamizo, 1999, García 2003), Reus (Arnavat et al, 1995), Menorca, Montilla-Sala 2008), Huelva (Aguilera and Rodriguez, 2008) and Logroño (Cerrillo, Iruzubieta and Fandiño, 2008). Their approach has been more institutional and social than demographic and they have underscored two features in the interpretation of the Spanish Milk Depot movement (Rodriguez Ocaña, et al, 1985); first, the influence on developing a market for new food products for children. Second, the fact that these institutions played a positive role in the diffusion of new hygienic practices related to breastfeeding and child nutrition in general. However, a central question remains to be evaluated, namely what was the impact of this health intervention on the improvement of children’s health? The evaluation of this impact as a positive effect was the main reason exhibited by doctors, and other health authorities, in their claims for the opening of new centers in the first two decades of the 20th century in Spain.

If Milk Depots had a positive impact on infant mortality, this should have been tested on a local level because they were local institutions. In the Spanish case, where no central authority coordinated the everyday life of each centre, this approach would have been particularly important. There is no regular statistical information for studying the role of Milk Depots in Spain at a national level. Available sources cover three

different kinds of documents: Statistical Yearbooks (local or national), Official reports (Ministry or provincial authorities) and Local records published by the Milk Depot itself. However, the statistical information required should cover the mortality conditions of the locality and the health performance of the centre. If this information were available and reliable, the task of evaluating the impact of the Milk Depot would be possible. This is the case for Barcelona's Milk Depot promoted by the city Council since 1906.

This paper has four main sections. First, it discusses the issue of the evaluation of health interventions from the past and it introduces a conceptual framework for evaluating the Milk Depot intervention. Second, it introduces levels and trends of infant mortality in Spain between 1900 and 1930, the views of physicians about how to reduce them and their proposals for improving breastfeeding with the foundation of Milk Depots. Third it reviews some basic characteristics of Spanish Milk Depots and fourth it combines an overview of the relationship between Milk Depots and levels of infant mortality in Spain between 1901 and 1935, with the study of Barcelona's Milk Depot at the "Breastfeeding House". In this last section, the paper evaluates the impact of the center on the infant mortality trends and the improvement of child mortality in the city between 1904 and 1935, before the upheaval caused by the Spanish Civil War.

2. Evaluating health interventions from the past: methodology and a conceptual framework

This study proposes an exercise in the evaluation of the consequences of this health intervention on infant mortality dynamics. Nowadays this kind of evaluation is commonplace in the literature on public health. It is worth remembering that a public health intervention means all kinds of actions for the promotion or protection of health or the prevention of ill health in communities or populations. Evaluation refers to the process of determining the value of something by judging it against explicit and predetermined standards.

This evaluation has mainly been carried out by experts in public health. However, demographers have also been made aware of the process, especially those working in the study of mortality and family planning campaigns (Rashad, Gray and Boerma, 1995; Khlai, 1996.)

Despite the early and lengthy debate on the role of public health in mortality decline, it is important to notice that the exercise of evaluating public health policies began later. Some published studies have had the specific goal of evaluating health interventions and have introduced new methodologies (see for example, Cain and Rotella 2001; Cutler and Miller, 2005). The traditional view has only been focused on final effects

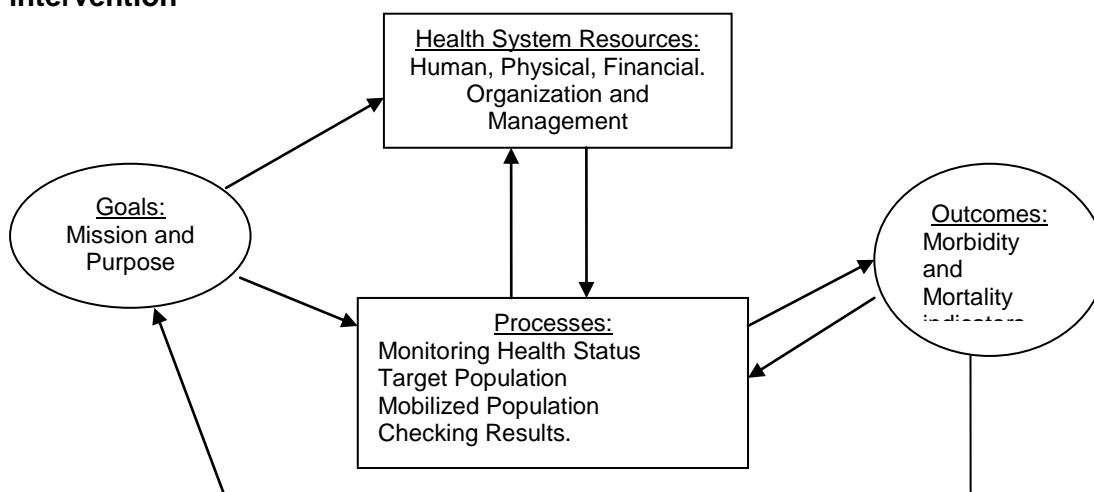
through the implementation of a very simple causality scheme, where, first in chronological order, laws were passed by the governments (local or national) and, as a result mortality declined (Szreter, 2005). The way in which the change in mortality levels followed the elaboration of these public health laws is believed to be the best evidence supporting the positive role of public policy in mortality decline. Nevertheless, the analysis of all components of every step involved in the process of implementing these laws and specific evaluations according to the kind of intervention proposed were lacking in these approaches.

The evaluation of health interventions in the 19th and the first third of the 20th century involves an adjustment in standard criteria because of obvious constraints on information and the methodological alternatives available. These constraints came from different sources. First, the data did not always fit statistical requisites for computing basic morbidity indicators. Second, interventions in the past are closed processes; there is no way of monitoring the different stages or phases of these interventions. Third, changes in historical context can interfere in many directions, modifying behaviors not directly related to the benefits of the intervention. All these constraints, however, can be qualified from a historical perspective, because the attempts at evaluating health results were carried out by health administrations at that time. It is well known that one of the factors driving the beginning of modern epidemiology was the need to collect evidence related, first, to the health conditions of populations and, second, to the outcomes of some public health activities.

Beyond all these difficulties, a conceptual framework is required in order to evaluate health interventions in historical populations. Figure 1 introduces a basic framework that can be applied to different kinds of interventions and especially to the evaluation of the role of Milk Depots. This framework proposes a combination of process and impact evaluation². There are four items that are the key points to be evaluated: goals, resources, processes and outcomes. Understanding the purpose of the intervention is the first step in the evaluation, it means trying to answer a question about what the health authorities were going to change in the health status of the population with their intervention. In order to calibrate the possibilities of the intervention, two basic aspects

² This framework follows the approach published by A. Handler, M. Issel and B. Turnock (2001) and L. Rychetnick, M. Frommer, O. Hawe and A. Shiell (2002)

Fig 1. Conceptual Framework in the evaluation of the Milk Depot intervention



must be taken into account: resources and processes. Resources mean all human, physical, , financial elements and, in general, management aspects that should be imple-

plemented with the resources available in order to achieve the desired goals. Finally, the outcomes are related to the set of morbidity and mortality indicators that permit an answer to the question about what difference the institution has made. A long list of items is needed for a complete evaluation exercise, but the historical nature of all the events evaluated and the specificity of the Milk Depots constrain the choices. Figure 1 shows what items are going to be evaluated in this study.

One of the main issues in this study is the evaluation of Milk Depots outputs. Two kinds of demographic impacts must be taken into account. On the one hand, a direct effect, caused by the control and reduction of those illnesses related to feeding practices and on the other, an indirect effect, through diffusion of new hygienic practices. Promoters of these centers were fully aware of these two effects. Both effects are quite difficult to evaluate. Whereas this first effect can be evaluated through the examination of infant mortality rates (all causes of death or deaths caused by digestive tract diseases) the second effect is related to the diffusion of new nursing practices. These new behavior won't be analyzed in this study because is quite difficult find data or collect evidence showing these kinds of changes.

Two approaches can be implemented when assessing the demographic impact of these centers. The first is illustrated in Figure 2, which shows the basic effects on infant mortality rate that can be expected from the intervention of the Milk Depots. These are: a) a change in trend, mortality levels remained stable until this institution began its activities, then mortality declined irreversibly. B) A change in slope, within a context of declining mortality, this institution accelerated decline and therefore the slope becomes

steeper. C) Changes in trend and slope, a simultaneous change in both parameters can be seen, meaning that the Milk Depot had a significant effect on infant mortality, simultaneously breaking with past health conditions and leading to a sudden improvement in child survival. This pattern of change assumed fast and intense success in controlling mortality caused by digestive diseases and in the protection of a high proportion of newborns.

A statistical way of implementing this first approach is the application of ITS (Interrupted Time Series) models. This is a straightforward methodology based on regression equations estimated through OLS³. In this study, the model to be applied is a basic formulation addressed at evaluating the effect of only one intervention. This is:

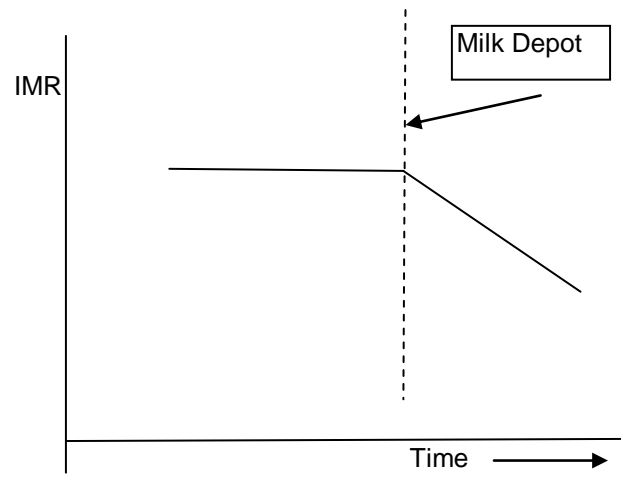
$$\ln(IMR_{(i,t)}) = \alpha + \beta_1 T_{(i,t)} + \beta_2 I_{(i,t)} + \beta_3 TPI_{(i,t)} + \beta_4 EP_{(i,t)} + \varepsilon_{(i,t)}$$

Where the dependent variable is a natural logarithm of infant mortality rate (IMR) for the city *i* and year *t*. Independent variables for the city *i* and year *t* are: *T*(*i,t*), a dummy variable counter for time from 1 (year 1901) to 35 (year 1935); *I*(*i,t*) a dichotomous dummy variable, the health intervention, scored 0 for observations before the Milk Depot's foundation year and 1 for observations before that year; *TPI*(*i,t*) a dummy variable counter for time, time post-intervention, scored 0 before the year of foundation and 1, 2, 3 for the remaining years; *EP*(*i,t*) a dummy variable scored 1 with sharp fluctuations in epidemic years and 0 when the mortality level was normal. This variable will be introduced into the model according to the particular behavior of each infant mortality series and *e*(*i,t*), the error term.

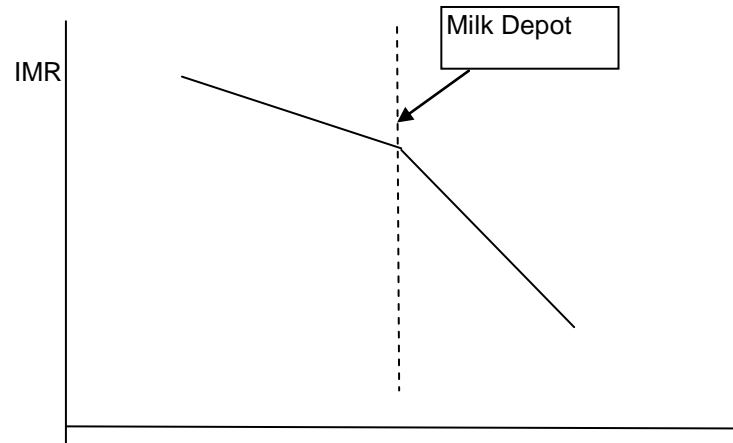
Some remarks should be taken into account when analyzing the results of the estimated equation. The effects can only be imputed to the Milk Depot if there was no other health intervention in progress, because if this were the case and the effects of this other intervention reached the children, this would obviously make it very difficult to disentangle the role played by each factor in the general improvement of survival.

³ Corrections for serial correlation will be introduced when tests require.

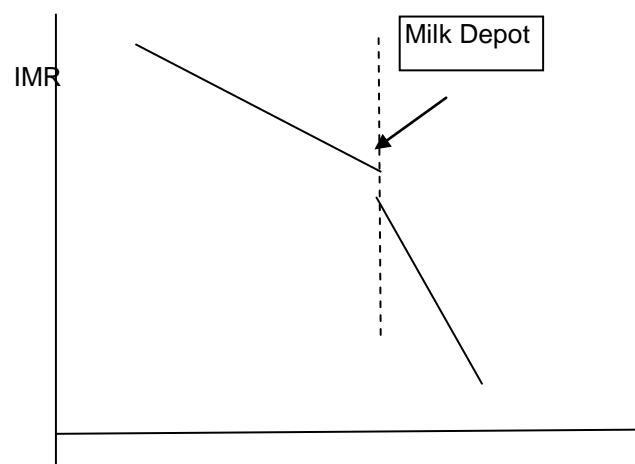
Figure 2
Patterns of change in Infant Mortality Rates caused by the Milk Depots intervention



(A)



(B)



(C)

Candidates for these overlapping effects are clean water technologies or food inspections or, even, economic change (related to changes in prices of food for children etc). This approach also assumes that, before the institution was opened, there was no public health activity for improving child nutrition, like providing sterilized milk without medical supervision, for example.

The second way of measuring the impact of the Milk Depots is based on the criteria of deaths averted. This evaluation is a sort of counterfactual exercise where the observed IMR is compared with an estimated IMR assuming that the Milk Depot didn't save any children's lives. This approach needed data that stated whether the children attending the Milk Depot were healthy or ill, and in this late stage, the children who were dying and those that were surviving were also reported. Thus, a second IMR can be estimated with new frequencies of children who died under the age of one, assuming that the above mentioned number of lives saved was zero. Two assumptions must be taken into account when calculating these estimates. First, that children surviving the Milk Depot did not die by any other cause of death before their first birthday. Second, that all surviving children had an equal frailty level, that is, every sick child attending that Nursing House had an equal chance of dying or surviving. It is obvious that these are strong assumptions and that their main consequences will be overestimations of the positive effect of this health intervention.

3. Infant mortality in Spain: trajectory and medical response (1900-1935)

In terms of its health transition and compared to the most advanced European countries, Spain is a latecomer to the process of epidemiological transition. Spain had to wait until the 1960s (Table 1) for its mortality rates to converge with European mortality rates as a whole. Infant mortality remained beneath the figure of one hundred deaths per thousand live births since the 1940s. In around 1930, the structure of the main causes of death was characterized by the predominance of infectious and childhood diseases. In the case of the infant population, during the first half of the 20th century two groups of diseases were responsible for more than fifty percent of total deaths. These were deaths resulting from diseases of the digestive tract and the respiratory tract. Table 2 displays the corresponding values and the associated percentage distribution of both types of causes of death. These results show how the general trend towards improvement in survival levels until the age of five went hand in hand with the corresponding reduction in the risks of dying from digestive diseases.

Thus, while in 1906 this risk was 60 percent higher than the risk of dying due to a respiratory disease, in around 1950 it was seven percent lower. As shown by the mortality statistics, within this predominant group of causes of death, diarrhea and enteritis were the most common. In 1930, these alone accounted for thirty percent of all deaths of children under the age of five.

Throughout the second half of the 19th century, Spanish physicians interested in “social hygiene” began to examine the causes of the high infant mortality rate (Rodríguez Ocaña, 1996, 1999). Some of the main reasons they pointed to were the unhealthy conditions of homes, poor eating habits and inadequate childcare (especially amongst working mothers). This diagnosis also linked infant mortality to the poverty in which a vast section of the Spanish population lived. Of these three factors, feeding took centre stage in medical concerns. A growing number of studies that were being published diagnosed the fact that the aetiology of the main cause of infant death at that time, diarrhea and enteritis, arose from the poor feeding practices of newborns. Along these lines, two types of negative habits were spotlighted: those related to nursing and those

Table 1

Comparative indicators of mortality

Average life expectancy at birth				
Areas in Europe				
Zones	1850-60	1900	1930	1960
Northern Europe	43.3	54.2	61.2	71.9
Western Europe	38.9	51.3	59.3	70.6
Spain	30.5	41.7	50.0	69.2
Infant mortality rate (IMR) and period when it dips below 100 per thousand				
Zones	1900-IMR per thousand		Period	
Northern Europe	117.75		Between 1880-1920	
Western Europe	172.8		Between 1909-1927	
Spain	202		1944	

Sources: Data from 1850-60 (Lee, 1979); remaining data (Casselli, Mesle, Vallin, 1999)

Table 2
Causes of death

Mortality of children under five due to selected diseases per thousand			
Diseases	1906	1932	1950
Digestive tract	98.4	61.6	22.74
Respiratory tract	60.8	47.3	24.45
All diseases	321.7	186.2	97.16
Mortality of children under five due to selected diseases (percentage distribution)			
Diseases	1906	1932	1950
Digestive tract	30.6	33.1	23.4
Respiratory tract	18.9	25.4	25.2
Remaining diseases	50.5	41.5	51.4

Source: Spanish Vital Statistics

related to the weaning period. The institutional response to these situations during the first half of the 20th century followed different stages in the trends aimed at protecting children that arose in Europe (especially France), as well as the political and social history of Spain itself.

In the specific realm of children's feeding, in the early 20th century, the main health care campaigns were aimed at creating Nursing Houses (*Casas de Lactancia*) and Milk Depots (*Gotas de Leche* in Spanish). Physicians designed these institutions with three main purposes in mind: a) the struggle against wet nursing, b) promoting maternal breastfeeding and c) changing hygienic practices related to child nutrition.

The logic of healthcare intervention in early 20th century Spain pursued two different yet complementary trajectories. One fit within a clinical perspective, while the other was social in orientation, albeit inspired by eugenics, just like in many European countries at the time. An overview of the development of digestive diseases is presented in an attached diagram (Figure 3). Spanish doctors at the time were aware of the existence of the different stages and conditioning factors of this sort of disease, of which deaths, due to diarrhea and enteritis, were the main group. However, modern knowledge of the aetiology of diarrhea was developed in the 1940s. In the early decades of this century, tallying the amount of bacteria present in cow's milk had gained ground as a standard practice for quality control of milk in both Europe and North America (Lee, 2006). In this way, the most effective capacity for action, as shown in the diagram, was preferentially concentrated in interventions aimed at lowering the prevalence of disease. There did not seem to be widespread consensus about therapies available at that time to lower the number of deaths. At least in Spain, the strategy pursued, once the disease had been declared, seemed to depend more on the medical schools or on the application of ad hoc remedies. Articles in several children's medical journals from the period, such as "La Medicina de los niños", (Reche Andrés 1981), bear witness to the presence and successive discussion of a variety of alternatives. In contrast, there was more agreement on the strategy aimed at stopping the succession of episodes of diarrhea, as the Milk Depots were a model of intervention with more or less standardized guidelines. Nor should we forget that the knowledge and medical technology available at that time prevented doctors from acting on all the risk factors related to the mothers' state of health.

The second trajectory was socially oriented and pursued a selective strategy (see Figure 4). Despite the fact that the child welfare movement in Spain supported protective measures for the entire child population and their mothers, within a movement of the medicalization of motherhood, which spread throughout Europe and America (Appel, 1987), in the specific Milk Depot approach, a priority target population was chosen, namely the children of poor families. This strategy combined the quest for improvements in their survival rates by controlling their food intake during breastfeeding, that is, the direct effects, with the spread of new hygiene practices among the rest of the population, which in the graph are called the indirect effects of

this activity. Doctors understood that by acting on this group, which was at the highest risk, progress could be made in lowering the overall child mortality rate.

The number of Milk Depots in Spain compared to the populations of nearby countries like France and Germany in the first third of the 20th century, which was a phase of rapid expansion around Europe, was quite small. Milk Depots had a low rate of diffusion in Spain. Estimates say that in around 1930, there were about 45 or 50 depots (Rodriguez Ocaña et al. 1985), but fifteen years before there were only around 26 or 30. That is, from 1890 to 1935 an average of one new institution per year was set up. In France, even with the incomplete statistics available, this number was 168 per year in

Figure 3. The logic of health intervention in Milk Depots

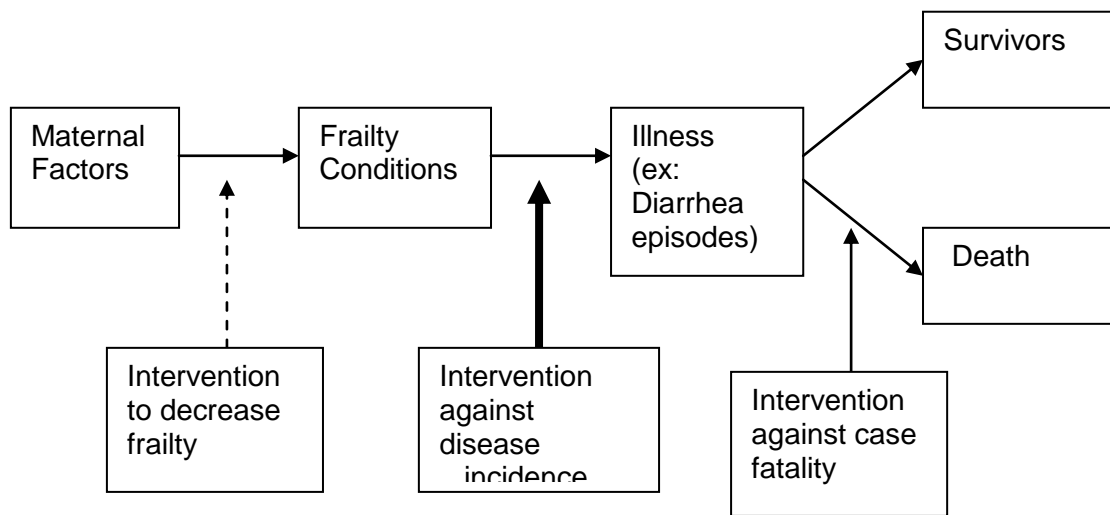
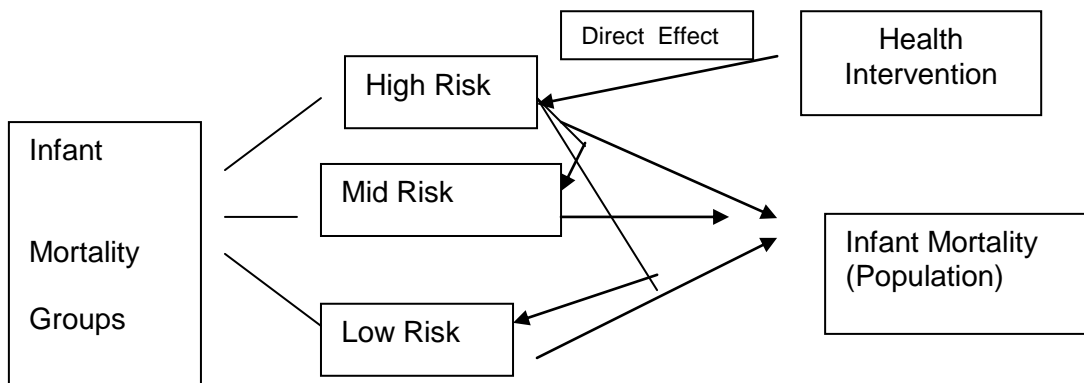


Figure 4. The strategy of childcare in Milk Depots



the period 1907-1932⁴. This entire process must be understood as a consequence of the new health administration in Spain after the crisis of the Old Regime, this administration was developed by laws passed in the second half of the 19th century. According to the centralized and united structure of the state, these laws designed a hierarchical organization in three levels: central (Spanish Ministries in Madrid), provincial and local. However, a lack of resources and other organizational problems left the final solutions of the main health problems under the initiative of every municipality; this was what occurred with the Milk Depots. In Spain, the central administration never implemented a plan in order to set up Milk Depots. These centers were promoted by three kinds of initiatives, isolated or in collaboration: Local Boards of Health (or Municipalities), individual initiatives by doctors specialized in medicine for children and Charitable Institutions. Throughout this period (1890-1936), the initial nature of these Milk Depots changed. They were becoming more like nursing centers, where doctors monitored the health condition of children and their mothers over several years, than places where taking care of children during breastfeeding period was the main task.

Most Milk Depots in Spain were founded in urban areas. According to the data collected in around 1915 there were 32 of these institutions opened in Spain (23 in provincial capitals) (see Annex 1). It might be useful, in order to understand the pattern of diffusion of this institution in Spain, to compare some characteristics of the cities that had Milk Depots, to the others that did not. Table 3 collects some indicators that seek to evaluate the relationship between the foundation of Milk Depots and some health and social “objective” conditions that could explain this foundation. They are represented by five different variables: mortality from diarrhea per one thousand births, doctors per one thousand inhabitants, charitable institutions per ten thousand inhabitants, literacy level of the female population (percentage) and the size of the urban population (proportion of the provincial population living in the provincial capital). Table 3 offers average but also, maximum and minimum values of these variables and differences between them. These results show how, in this first phase, the Milk Depots were opened in provincial capitals with lower levels of mortality from diarrhea, but a higher ratio of doctors and charitable organizations per inhabitant, a higher proportion of literate women and population living in the capital than the other provincial capitals, without these institutions. However, the range of variation between maximum and minimum values reveals a greater homogeneity in this second group of capitals than in the first. In fact, a review of the list of the names of these urban depots (see Annex 1)

⁴ Estimate from data published by Rollet-Echalier (1990, 387).

reveals that the major Spanish cities set up Milk Depots right from the beginning. It should be born in mind that 13 of the 23 provincial capitals with these centers had more than 50,000 inhabitants and 7 of these 13 had more than 100,000. If these institutions were set up by local initiatives, it seems that those localities with higher health standards and organizations, could respond more quickly than others to the “perception” of infant mortality levels as untenable. It should be noticed that big cities such as Barcelona, Bilbao, Madrid, Seville and Valencia were promoting changes in their health organizations from the 1880s, for example, building biological and chemical laboratories or new hospitals, some specifically for the child population. These cities probably act as centers of diffusion for these new methodologies and new ways of fighting against child mortality. It can be observed in some initiatives that previous contact with doctors or authorities in one of these pioneering places was the beginning

Table 3
Location indicators of Milk Depots in Spain before 1915

Provincial status		Mortality by diarrhea 1906-07	Charitable Organizations per 10,000 Inhabitants	Doctors per 1,000 Inhabitants	Literacy Female Population percentage	Urban Population percentage
With Milk Depots	Average	73.00	6.69	3.13	65.79	20.58
	Maximum	167.68	21.97	5.06	86.40	68.27
	Minimum	33.51	1.25	1.01	28.95	3.87
	Difference	134.17	20.72	4.05	57.44	63.40
Without Milk Depots	Average	80.88	5.04	2.87	56.77	7.95
	Maximum	141.06	18.89	4.69	85.96	15.41
	Minimum	34.83	0.69	1.22	34.55	4.31
	Difference	106.23	18.19	3.47	51.41	11.09

Sources: Mortality by diarrhea 1906-07: Spanish Vital Statistics. Charitable Organizations: "Los Nuevos Apuntes para el estudio de..." Madrid 1915. Doctors, Literacy Female Population and Urban Population: Spanish Population Census year 1910

Table 4
Locational determinants of Milk Depots
Logistic Regression Results

Variables	B	S.E	Wald Test	Signif Level	Exp (B)
Constant	-6.409	2.591	6.120	0.013	0.002
Mortality rate from diarrhea	0.006	0.014	0.168	0.682	1.006
Charitable Organizations	-0.033	0.078	0.177	0.674	0.968
Doctors x 1000 Inhabitants	0.056	0.491	0.013	0.910	1.057
Literacy. Female Population	0.052	0.035	2.201	0.138	1.054
Urban population	0.235	0.078	9.005	0.003	1.265

of the Milk Depot’s project. For Logroño and Gijon, this was where the promoters seemed to have been in touch with one of the leading doctors in the diffusion of this movement, such as Dr Ulecia in Madrid.

A way of testing the effect of each variable in the foundation of a Milk Depot until 1915 is to run a logistic regression (Table 4). Results show how most of the variables did not

have a statistically significant effect. That is, some “objective” conditions, such as mortality levels, availability of doctors or literacy did not seem to be relevant in the “explanation” of this first pattern of diffusion of Milk Depots. The only variable showing a significant effect is the proportion of people from the province living in the capital. According to previous observations, it seems that urban areas, particularly the largest Spanish cities in this period (1890-1915), were able to mobilize resources for opening Milk Depots. In any event, it should also be recalled that in these cities, there were probably other institutions that cared for children during breastfeeding, such as the so-called “Casas Cuna” (Cradle Houses) or “Asilos Guarderías” (Nursery Asylums), as well as the institutions charged with caring for abandoned newborns. At some of these centers, the breastfeeding took place via wet nurses, whose health status must have been subject to supervision.

4. Milk Depots in Spain: Resources and Processes

In order to achieve the health authorities’ goals, different resources were needed. Table 5 offers a synthetic view of these resources in six Spanish Milk Depots, according to data available from published studies and statistical sources⁵. In spite of some inevitable simplifications, this description seeks to calibrate the basic coincidences and differences between the various centers. A first comparative view of all characteristics collected rejects any idea of uniformity in the way each Milk Depot worked. In fact, as may be expected, each institution worked according to its environment and local circumstances. In terms of organizational standards, three kinds of patterns can be differentiated: a) Public Milk Depots: where municipalities subsidized them and provided medical staff and other physical resources like, for example, the buildings. This seems like the intervention method for big urban areas, such as the two main Spanish cities, Barcelona and Madrid b) Private Milk Depots, These were initiatives supported by charitable institutions and promoted by a specialist doctor in Pediatrics. Dr. Ulecia’s medical center in Madrid was an example of this, c) Mixed-Public and Private Milk Depots: an intervention model where a private initiative received support from other social groups and where public administration came later, providing partial financial support. This was the case for Milk Depots in Mahon and Reus.

⁵ In order to keep references at a minimum all the information about the localities in this section comes from: Alicante (Perdiguero-Gil and Berbanau-Mestre, 1990, 2005), Barcelona (Statistical Yearbook and Barcelona’s Official Journal), Madrid (Rodríguez Ocaña et al. 1985, Majan 1990), Mahon (Motilla and Sureda, 2008), Reus (Arnavat et al., 1985). When data come from other localities, references will be quoted in the text.

The size of health staff depended on the size and number of health services supplied to the population. Obviously, Milk Depots in big cities like Barcelona and Madrid required

more health workers than small towns such as Reus and Mahon. However, if we were to calculate the frequency of staff per inhabitant we would see that there were almost two health workers for every ten thousand inhabitants in these two cities, whereas in Madrid and Barcelona, this ratio was estimated at around one thousand. Thus, big cities seemed to provide less medical staff than mid-size cities. Medical attention was planned according to the social strategy promoted by this institution. Two kinds of medical attention were designed according to legislation; one focused on social priorities, mainly health relief for poor families, and the other was based on social differentiation between groups. Priority medical attention for poor families was a characteristic of Milk Depots supported by City Councils, like in Madrid and Barcelona. Distinction between social classes in children attending the institution can be observed in Mahon, Reus and Dr Ulecia's Clinic in Madrid, all three of which were supported by charitable institutions. In this last Milk Depot wealthy and poor families saw the doctors on different days of the week.

With the exception of Milk Depots sponsored by City Councils in Madrid and Barcelona, information available from the other center seems to suggest that funding was based on a combination of sources, independently of who establish the center. In general, there is no evidence of huge financial problems in these centers. Although, on occasion help was needed from a private donor to open an institution, as occurred in Reus, or demands for financial support were planned through different charities, as was the case of Alicante, where between 1926 and 1935 46 percent of the budget came from a Charity Ball⁶.

Four indicators have been chosen in order to evaluate the processes: target population, mobilize population, monitoring health status and checking results (Table 6). Detailed information about these indicators is not available in all cases. In one particular case, that of target population, there were problems of statistical reliability and interpretation of the published data. Unfortunately, quantitative evidence for the remaining indicators is scarce. In particular, the lack of information about the mobilized population imposes an important limitation to the evaluation of the diffusion of a new practice for feeding newborn babies. This process was one of the key factors in the Milk Depot strategy promoted by doctors and health authorities.

⁶ An automatic search on news about Milk Depots in Spain between 1905 and 1935, in the journal "La Vanguardia" (Barcelona newspaper), has collected 180 references 40 percent of which informed on charitable activities carried out by local Milk Depots around Spain.

Table 5 Evaluation of Health Resources in some Spanish Milk Depots

Milk Depot Center Place-Date-Population	Founder	Institutional Nature	Government	Medical Attention	Health Workers	Financial Resources	Financial Standing
Madrid 1904 Pop 1900: 539,835.	Dr Ulecia	Private Charitable	Private Council	According to social group	13	Subsidies from Town Councils State	Stable
Barcelona 1904/914 Pop 1910: 587,411	Town Council	Public	Town Council	Priority: Poor families	62	Subsidies from Town Councils	Stable
Mahón 1906 Pop. 1900: 17,144	Local association	Private Charitable	Board of directors	According to social group	3	Subsidies from different administrations Private Donors	Stable
Madrid 1913 Pop. 1910: 599,807	Town Council	Public	own Council	Priority: Poor families	n/a 6 (1920's) 12 (1930's)	Subsidies from Town Council	Stable
Reus. 1919 Pop. 1920: 30,266	Dr. Fàbregas	Public	Board of directors	According to social group	n/a	Private Donor Subsidies from administrations Fees (with the exception of poor families)	Stable
Alicante 1925 Pop. 1920: 63,908	Town Council	Public	Town Council	Priority: Motherless, illegitimate, foundlings		Subsidies from administrations (local and provincial) Fees Charity	Stable

Source: Madrid: Majan (1990), Spain's Statistical Yearbook. Barcelona: Barcelona's Statistical Yearbook. Mahón: Motilla, Sureda (2008). Reus: Arnavat et alt. (1995). Alicante: Perdiguero, Bernabeu (2005).

Children were the target population, Milk Depots would accept them according to two criteria: age and social group. Newborns were obviously admitted to all Milk Depots, they were monitored during their breastfeeding period in most of the centers until the weaning period. However, in Reus for example, they also accepted children and adolescents, and in Barcelona, Milk Depot regulations advised children who deserved "special attention" until they went to school to be kept under medical supervision. From

a social point of view, all Milk Depots gave priority attention to poor families providing them with free medical assistance and milk. However, they also planned the same facilities for rich families or other social groups. In these cases, medical services were not free. For example, Dr Ulecia's Clinic and Reus' Milk Depot had special fees for rich families, or fees according to social status, like in Mahon.

The estimates of births under protection of Milk Depots are a key quantitative indicator in this evaluation of a target population. In Spain, there are no regular or centralized statistical records of their number and evolution. The only two sources of statistics that seem to be available for getting a somewhat global view of their distribution and effect on the child population are "Los Nuevos apuntes para el estudio y la organización de las instituciones de Beneficencia y Previsión" (New Notes for the Study and Organization of Charitable and Prevention Institutions). These were published by the Ministry of Governance (equivalent to a Ministry of the Interior in today's government) in 1915 and the Statistical Yearbook of Spain for the years 1916 to 1923. The first source contains an inventory of both Milk Depots themselves and of other institutions charged with caring for children during breastfeeding. The list of Milk Depots cited dovetails with the one provided by other authors from this period, as does the observation, especially in the largest cities in Spain at the time, Madrid and Barcelona. The only absence noted is two centers founded prior to the date of publication: Guadalajara (1911) and Malaga (1906). There is a total of 26 centers inventoried, plus the two latter ones. The second source comes from the statistics on Milk Depots published regularly in the Statistical Yearbook between 1916 and 1923⁷. They contain just two figures: the number of children fed and the total number of liters of milk distributed. Even though here it would be impossible to embark on a detailed assessment of the shortcomings of this source, we would advise that the main difficulty in using it lies in the interpretation of the number of children fed⁸. To use these figures, we have had to introduce an assumption as to the average length of treatment of breastfeeding children at the Milk

⁷In this source, the Milk Depot list reports 30 provincial capitals of which only four seem not to be Milk Depots, because the year of foundation was later. They were probably included because there was a hospital (or a charitable institution) providing milk to children of poor families.

⁸In some provincial capitals, the total number of children tallied does not seem to dovetail with the actual child population. For example, in the city of Tarragona, the yearly average number of children treated between 1918 and 1923 was 3,650, whereas the average number of births per year was only 553. In fact, an exercise in comparison between the series of children treated at Milk Depots and the statistics on the same institution in Madrid, also published in the statistical yearbook, reveals the existence of discrepancies between both sources. While the total number of liters of milk consumed is faithfully stated, the tally of children treated is not.

Table 6
Indicators of processes in selected Spanish Milk Depots

Milk Depot Cities	Period	Target (a)	Population Other criteria	Mobilized Population		Monitoring Health Status	Checking Results
Barcelona	1920-34	6%	Children age and social group	1919-21: 3,4%	1929-31:2,2%	yes	yes
Madrid	1920-34	13%	Children age and social group	1919-21: 4,1%	1929-31: 5%	yes	yes
Alicante	1928-30	6%	Children age and social group		1929-30: 1,8%	yes	n/a
Reus	1923-34	31%	Children age and social group	n/a		yes	yes

(a) Target Population: (Newborns attending Milk Depot/Total Births)* 100
 Mobilized Population: (Mothers attending Milk Depot/Married women (20-34 y))*100

Depots⁹. Despite all these shortcomings, it might be useful to undertake a preliminary exercise in quantification for all the Depots referred to in the yearbooks and the statistics available for the Milk Depots in Madrid and Barcelona, plus others extracted from different monographs. Given the kind of figures available, we can only calculate the proportion of children admitted to or protected by the institution over the number of births in each city. As Tables 6 (first column) and 7 show, in the majority of cities this proportion would have been under ten percent (an average for the whole country of 8 percent¹⁰). Therefore, it seems exceptional that at that time more than 20% or 30% of the newborns would have expected to be cared for during the nursing phase. Even

Table 7

**Proportion of children fed in provincial capitals
(over total births) 1916-23**

Interval (%)	Number of capitals
< 5	13
5--9	9
10--14	4
15--19	3
> 20	4
Spain-mean	8.24%

Source: Spain's Statistical Yearbook

though it is practically impossible to find out the percentage of newborns in what we could call high-risk groups in these cities, it does seem plausible to assume that with the percentages obtained, broad swaths of the child population would have been exposed to digestive diseases and their fatal consequences. Nevertheless, children attending the Milk Depots and those under medical supervision were not the only infant population helped in these centers. Especially in the two large cities, Barcelona and Madrid, there were a number of breastfed children who were supervised through the provision of feeding bottles with sterilized milk. Another group was mothers feeding

⁹The total milk consumption at each Depot would be equal to the product of the number of children cared for multiplied by the average consumption of each child and by the average number of days of children treated can be calculated based on the total number of liters consumed.

¹⁰ Notice that this 8 percent has only been calculated with urban births. For all births, this value is 1.02 percent. In France, around 1920, the proportion of children under Rousset's law protection was between 6 and 7 percent. (Estimate from data published by INSEE, *Annuaire statistique* 1951 and reproduced in Roller-Echalier, 1990, 480. Number of births from INSEE's Web page). These are rough values, because data on children under protection and number of births do not match for the same number of "Départements".

their babies with their own breast milk. Unfortunately, it is quite difficult to work out a reliable estimate of the number of children controlled outside these centers, the data available are quite different. Numbers published for the “Breastfeeding under observation” (Lactancia vigilada in Spanish) regime for Madrid, estimate that around 25 percent of total births in the city from 1920 to 1929 were children that were under observation and 40 percent from 1930 to 1934. Whereas the Barcelona Milk Depot computes lower values at 3 and 1.7 percent in these two periods¹¹.

The population mobilized by the Milk Depot includes two population sectors. First, the mothers attending these centers with their children and, second, married women, who expected to become mothers and needed to be trained in modern nursing practices, which they were made aware of through conferences, courses and propaganda. The first estimate can be approximated by the number of children attending the Milk Depots (assuming one birth per mother) by the total number of births in the first column of Table 6. The second column in Table 6 tries to estimate the other population sector. Assuming again that the mothers only gave to birth one child each, we have calculated the proportion of all married women aged between 20 and 34 years that were attending the centers in each locality. Between 2 and 5 percent of women within the central reproductive ages at that time seemed to have been reached by the intervention of the Milk Depot. Health authorities were probably aware of the limited direct impact of these centers and as a result put their efforts towards public campaigns publicizing proper childcare practices (Rodríguez Ocaña and Perdiguero, 2006). Unfortunately, there isn't any regular information about people attending courses or conferences on hygiene or childcare. The Nursing House of Madrid estimates that, from 1918 to 1928, 12,000 mothers made up the total population attending conferences on maternity topics (Ayuntamiento de Madrid 1929, 137). This amount represented an average of 6 percent of all the mothers in that period.

¹¹ Data for Madrid were published in the Spanish Statistical Yearbook and for Barcelona in the monthly reports published by the City Council. According to these statistics the number of children attending this breastfeeding system was growing in Madrid from 2,503 in 1916 to 9,893 children in 1933, whereas in Barcelona that amount was around 350 per year.

Table 8
Comparative Patterns of Breastfeeding
Proportions of mothers attending Milk Depots according to the kind of breastfeeding

Periods	Madrid			Barcelona		
	Mother's Milk	Artificially fed	Others	Mother's Milk	Artificially fed	Others
1905-09	42.71	13.83	43.46			
1910-14	51.73	12.86	35.41			
1915-19	63.33	12.43	24.23	64.31	15.83	19.86
1920-24	67.77	9.92	22.31	71.92	12.79	15.30
1925-29	50.28	33.54	16.18	75.25	14.30	10.45
1930-34				70.47	20.95	8.57

Source: Madrid (Maján, 1990), Barcelona (Barcelona's Official Journal 1915-1934)

Another perspective about the population mobilized can be obtained from the data on the kind of feeding practiced by mothers attending the Milk Depots. As mentioned previously, the main aim of health authorities was to encourage maternal breastfeeding. However, because these authorities were worried about milk quality control, they provided sterilized milk to the mothers when they couldn't feed their babies. Some doctors criticized this practice because, in their opinion, this strategy was pushing mothers towards artificial feeding. Nevertheless, data available from Madrid and Barcelona (Table 8) suggest that an improvement in maternal breastfeeding was achieved, at least for a significant period, especially in the 1910's and 1920's. In this last decade, the proportion of mothers practicing this kind of feeding reached around 70 percent in Madrid and 75 percent in Barcelona. This trend changed in these two cities when the percentage of artificially fed children attending the Milk Depot increased reaching 30 percent in Madrid (1925-29) and 21 percent in Barcelona (1930-34). These changes in feeding patterns were quite significant in small cities. According to the data collected from Huesca (Loste, 1933) and Huelva (Aguilera and Rodriguez, 2008), the low proportion of mothers breastfeeding their children during their first years increased rapidly. For example, in Huesca from 1926 to 1928 an average of 25 per cent of children were breastfed by their mothers, whereas, in 1931 this proportion reached 86 per cent. The same kind of feeding changed in Huelva from 2.7 percent in 1923 to 45.9 percent in 1929. The basic interpretation of these results given by the physicians explained the changes as being a consequence of the diffusion of new education on childcare among new mothers. However, this educational effect might have been a consequence of some regulations set up by the institutions themselves. A particular case is that of Barcelona's Milk Depot where the new regulations passed in 1922

promoted the admission of children in good health and mothers feeding using their breast milk.

Monitoring health status was a common practice in the Milk Depots. Under the influence of their French colleagues, Spanish doctors developed cards where they recorded basic biometric parameters of the physical evolution of every child. Following the same influence and other international examples, these centers monitored results and health outputs. Checking results was a common practice, no matter the size of the center. Dr. Ulecia's Clinic in Madrid published reports analyzing the number of children attending the institutions, the kind of breastfeeding and other characteristics. Milk Depot regulations in Barcelona stated that statistics of its health activity should be published on a monthly basis. Statistics from the Nursing House and Milk Depot in Madrid were collected in the Spanish Statistical Yearbook between 1918 and 1933. Reus' medical journal "Puericultura" published basic data on the children that attended the Milk Depots, milk consumption and other characteristics. In all these cases, the objective seemed quite clear: to confirm the positive role played by the institution in the decline of infant mortality in each locality.

5. Evaluation of Milk Depot Outputs in Spain: An overview and the case of Barcelona's Breastfeeding House

In this section, the assessment of the impact of Milk Depots on levels of child mortality in Spain will be worked out through three different kinds of perspectives. First, with the estimation of the ITS model introduced in section 2; second through the study of the relationship between mortality rates from diarrhea and enteritis and the estimated levels of children fed by Milk Depots in the provincial capitals, and third with a basic analysis of Barcelona's Breastfeeding House.

The ITS model has been applied to data from 13 Spanish provincial capitals and one mid-size locality in Catalonia (Reus). All data have been chosen because of the information available about the year of foundation of this health institution and the number of observations before and after that year¹². Most of these localities set up Milk Depots between 1910 and 1920. Figure 5 shows different patterns in IMR behavior before and after these centers began regular activity in three Spanish localities; Reus, Granada and Pamplona. These patterns can be considered representative of three types of IMR response to Milk Depot's opening. Reus shows the case where the

¹² Keeping a minimum of ten observations before and after the foundation of the Milk Depot.

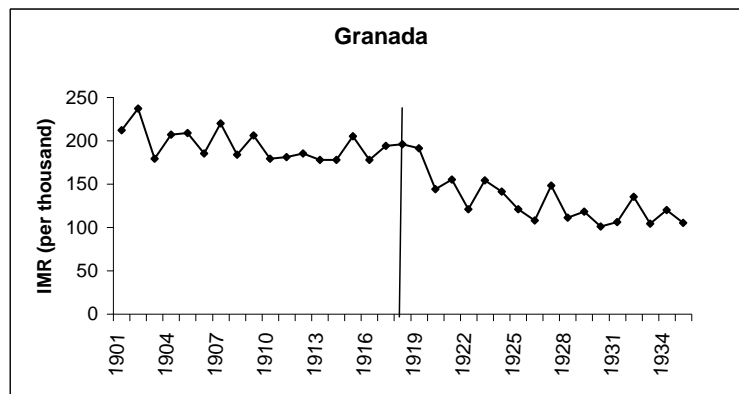
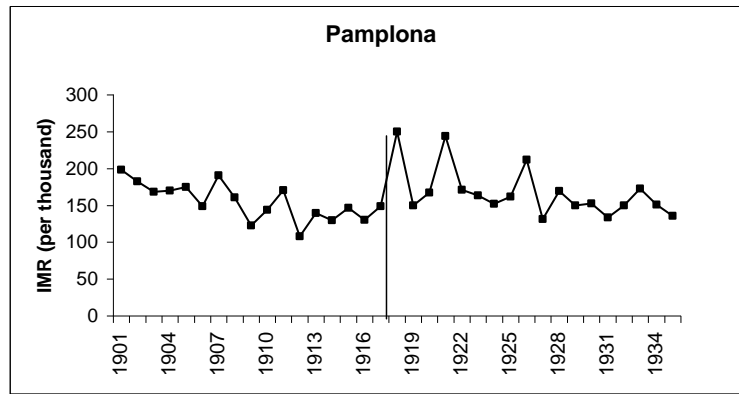
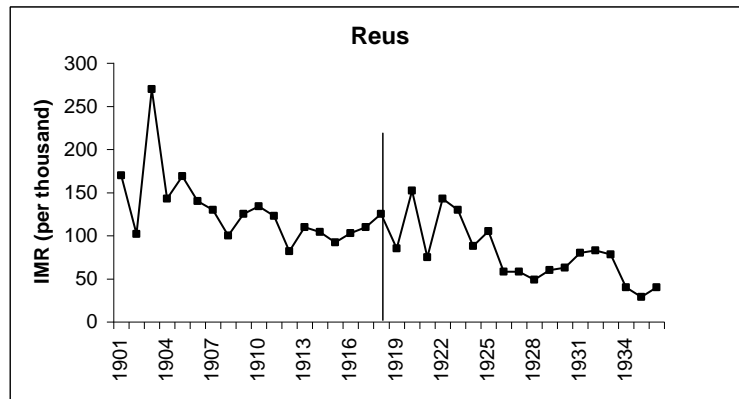
institution worked within an environment of mortality decline. Granada represents a locality where a clear difference can be observed between the stable level and trend in IMR before the opening and the mortality decline after the Milk Depot's foundation. Data from Pamplona suggest a peculiar situation where IMR behaved worse after the Milk Depot was set up than before.

In order to achieve an accurate understanding of the results obtained from the fitted equations, a prior presentation of the hypothesis is needed. It is important to be aware that in the ITS model, Beta(1) estimates the general trend before the health intervention, and it is expected that Beta(1) will be statistically significant and negative, because IMR declined in all of these cities. Beta(2) estimates the post intervention change on the intercept and is expected to be positive and statistically significant, because the health intervention promoted by this center made a clear difference between the past trend and level and the new ones. Beta(3), estimates the post-intervention change in a slope, where, again, it is expected to be statistically significant and negative because after the Milk Depot's foundation IMR declined irreversibly.

Estimates from the equations fitted to each locality are collected in Table 9. Three basic results deserve attention:

- a) In eight cities (Reus, Alicante, Granada, Ciudad Real, Huelva, Lerida, Valladolid and Guadalajara), Beta(2) are not statistically significant. This means that there is no evidence of change in infant mortality conditions caused by the Milk Depot.
- b) In the other five cities where Beta (2) coefficients show statistically significant effects, the post-intervention slope (Beta (3)) presents a positive sign. This sign means an increase in infant mortality rates, which is the opposite result expected from a successful health intervention. The only exception seems to be Barcelona where Beta(3) is negative, but this result should be taken cautiously because this city was implementing other health policies and a more conclusive diagnosis requires a detailed examination beyond the scope of this study.
- c) Data on IMR from diarrhea allows a more accurate evaluation because this digestive disease was the main target in the health intervention. These data are only available from Barcelona and Pamplona. Beta(2) estimates are not statistically significant in both cases which means that the Milk Depot facility didn't have any positive effects on the dynamics of this disease in the child population.

Figure 5
Infant Mortality Rate Series and the foundation of Milk Depots in three Spanish localities



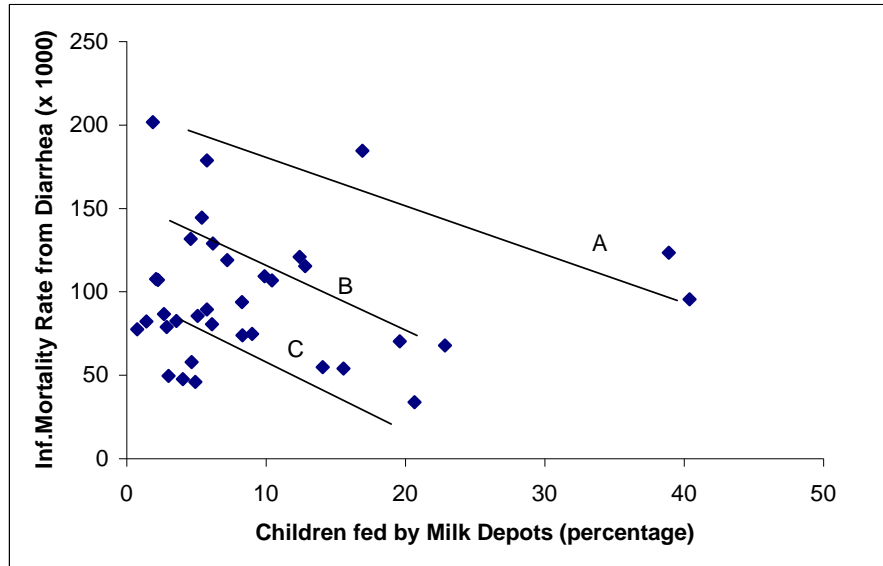
Source: Reus (Arnabat et al (1995)); Pamplona (Anaut, 1998); Granada (Arbelo, 1962)

Table 9
ITS models fitted to Spanish localities with Milk Depots founded from 1910 to 1925

Locality/ Year of foundation of Milk Depot	$\beta(1)$	<i>p-sig.</i>	$\beta(2)$	<i>p-sig.</i>	$\beta(3)$	<i>p-sig.</i>	$\beta(4)$	<i>p-sig.</i>	R-Squared	DW
Reus (1919)	-0.021	0.10	0.242	0.18	-0.039	0.04	0.674	0.02	0.66	1.75
Pamplona (1916)	-0.029	0.00	0.279	0.00	0.026	0.00	0.336	0.00	0.65	2.24
Pamplona (1916) (a)	0.052	0.53	0.719	0.17	-0.201	0.06	0.484	0.02	0.73	2.01
Alicante (1925)	0.015	0.01	0.088	0.40	-0.083	0.00	n/e		0.72	2.09
Granada (1916)	-0.011	0.12	0.024	0.75	-0.02	0.02	n/e		0.81	2.30
Ciudad Real (1921)	-0.009	0.10	0.049	0.60	-0.028	0.01	0.292	0.00	0.75	2.33
Huelva (1924)	0.001	0.63	-0.012	0.89	-0.056	0.00	n/e		0.7	1.53
Valencia (1910)	-0.074	0.00	0.209	0.03	0.053	0.00	n/e		0.77	2.28
Lerida (1918)	-0.045	0.00	0.092	0.51	-0.012	0.38	n/e		0.85	1.54
Coruña (1912)	-0.054	0.00	0.317	0.00	0.039	0.00	n/e		0.54	1.59
Valencia (1910)	-0.023	0.21	0.024	0.82	0.008	0.64	0.374	0.00	0.65	1.39
Guadalajara (1911)	-0.031	0.08	0.197	0.08	0.008	0.65	0.388	0.00	0.65	1.84
Oviedo (1912)	-0.021	0.04	0.177	0.02	0.009	0.38	0.321	0.00	0.51	2.23
Barcelona (1914)	-0.010	0.20	0.177	0.00	-0.035	0.00	0.213	0.02	0.95	2.01
Barcelona (1914) (a)	0.039	0.33	0.155	0.18	-0.099	0.027	0.275	0.01	0.93	2.10

(a) Dependent variable: Infant Mortality Rate from Diarrhea
n/e Not estimated

Figure 6
Spain 1918-23
Children fed by Milk and Mortality rates from Diarrhea
(provincial capitals)



Source: Infant Mortality Rate from Diarrhea: Spanish Vital Statistics. Children fed by Milk Depots : Statistical Yearbook

A second step in the assessment of the Milk Depots' impact is the study of the relationship between the average mortality rates of children under the age of two from diarrhea and enteritis, and the estimated levels of children fed by Milk Depots in the provincial capitals (1918-23). (Figure 6). The scattered diagram suggests that this relationship exists as indicated by lines A, B and C. These are three groups of cities, where each group does not belong to a homogeneous region. Average levels of infant mortality from these causes were also different, 156.69 per thousand in A, 111.42 per thousand in B and 73.09 per thousand in C. As a result of the unequal distribution and low number of cases in these groups, the lines only suggest a negative correlation between the two variables¹³. That is, that for a certain mortality level the town with the highest proportion of children receiving milk attained higher survival levels (lower mortality rates). If we take into account the differences in the mortality rates, having a higher or lower proportion of children cared for would offer a comparative advantage. In very similar mortality conditions, supplementary feeding in suitable hygienic conditions would raise the probability of survival. However, this figure also shows that

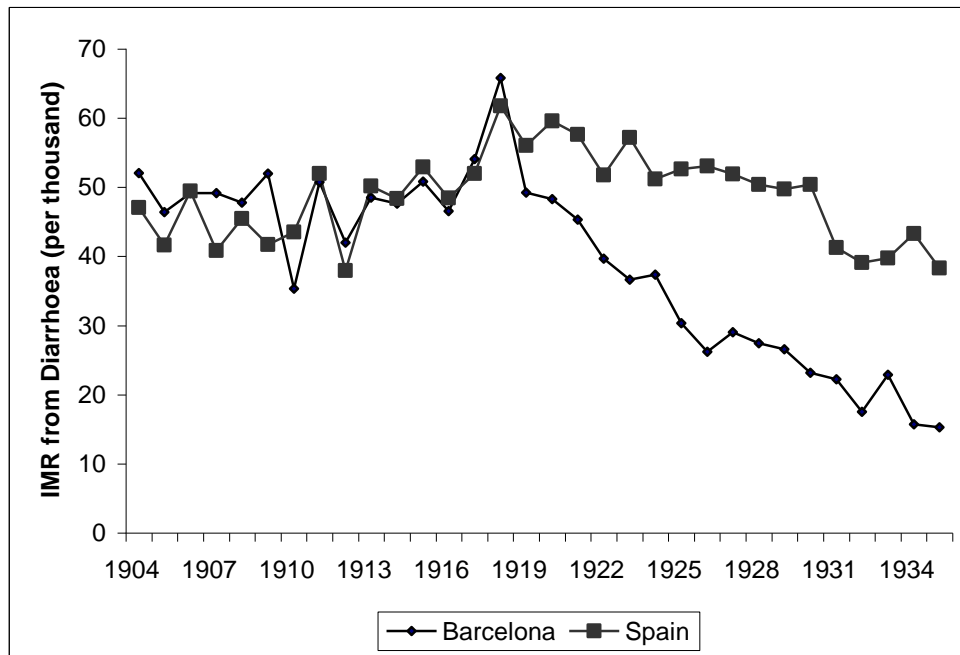
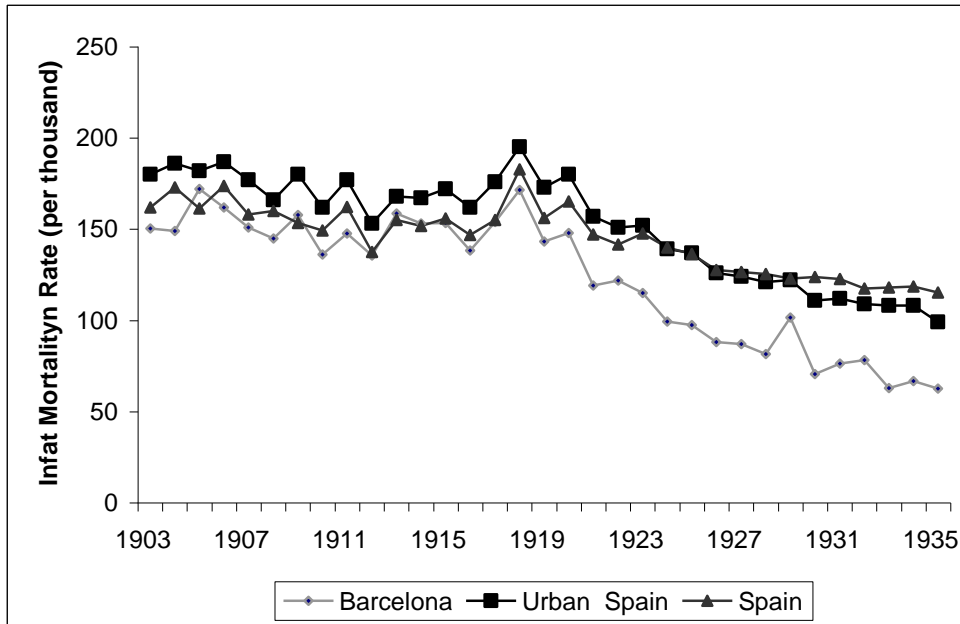
¹³ Lines are not fitted with a statistical procedure. Number of cases: 5 (A), 10 (B) and 21 (C). Simple correlations between these two variables within each group: -0.95 (A), -0.94 (B) and -0.55 (C).

other factors came into play on the lethal nature of these diseases and that these factors remained outside the scope of control of these centers.

Infant mortality trends in Barcelona at the beginning of the 20th century were around 150 deaths per one thousand live births¹⁴, which is close to the entire Spanish

¹⁴ All infant mortality rates are “legal” mortality rates because in the Spanish Civil Registry only recorded births (and deaths) after the first day of life.

Figure 7
Infant Mortality in Barcelona and Spain (1903-1930)



Source: Infant Mortality Rate: Spain and Urban Spain (Gómez Redondo, 1992).
 Barcelona: Barcelona's Statistical Yearbook. IMR from Diarrhoea: Spain Pascua (1934)

population and a little lower than the average child mortality for the provincial capitals, this being the only available measurement of urban mortality (Figure 7). From then until the 1920s Barcelona followed the Spanish trend, but throughout that decade, infant mortality decreased irreversibly. Around the mid 1930s infant mortality rates were below one hundred per thousand in Barcelona. The average level of diarrhea mortality rate in around the first two decades in Barcelona and Spain was very close (Figure 7) but in the 1930s this figure fell by half in Barcelona, whereas in the rest of the country the mortality rate remained at around 40 per thousand.

The process of improving baby-feeding methods in Barcelona was made in 1890 by doctor Francisco Vidal Solares. He founded the “Hospital de Niños Pobres” (*Poor Children’s Hospital*) an office devoted to treating children’s diseases and educating mothers. Its main purpose was to help mothers with their breastfeeding problems. It is often regarded as the first Milk Depot in Spain, but this was not the main health purpose of the institution. In the city of Barcelona, a Milk Depot of this kind (“Casa Municipal de Lactancia” *Breastfeeding House*) was created in 1903 and came under the control of the city council, the budget and staff were provided by the political authorities. It was refunded in 1914 after opening a new building and reshaping all the medical specialties related to pregnancy and pediatrics. In fact, the Milk Depot was integrated into a Nursing House. A private and charitable organization set up a third initiative for improving breastfeeding and child nutrition in 1920, “Lucha contra la Mortalidad Infantil” (*Fight against Infant Mortality*). A community clinic was opened where mothers from poor families received medical attention and, if they couldn’t feed their babies, sterilized milk. However, between these three institutions only the Milk Depot from the City Council could offer a large number of places. In the “Hospital de Niños Pobres”, no more than 45 babies could be fed daily and around 20 or 25 in the community clinic “Lucha contra la Mortalidad Infantil”. In the Nursing House’s new building, this number reached 160 babies a day. However, this is not only the main difference, as could be expected; the size of the medical staff was also greater in the Nursing House than in the other two institutions. Unfortunately, there is only a detailed list of all health workers for this Nursing House and not for the others. In 1926, around 62 people (physicians, nurses and midwives) worked there.

Data published in the monthly statistical reports classified children attending the Milk Depot into two health statuses: healthy or ill (See Figure 8). The number of children in good or ill health that attended the institution was reported every month (and therefore every year), and the children leaving were classified as either dead or survivors. If we

accept the assumption that all these dead children were classified as ill when they attended the Milk Depot (transition A) a key variable can be estimated, which is, the proportion of children recovering from sickness. Data about the number of children that, after arriving in good health, became ill (transition B) is the only information lacking in these published statistics. It is plausible that this proportion was not very high and may have been close to zero, because children were carefully monitored at all times in the Milk Depot, an indirect estimate will be needed however.

According to this diagram, if the number of children that were sick prior to their arrival at the Milk Depot and then recovered and left were known, it would possible to estimate an indicator such as the number of lives saved, or the number of deaths prevented by this health intervention.

Fig 8. Flow diagram for interpreting data published about the health status of children attending Barcelona’s Breastfeeding House.

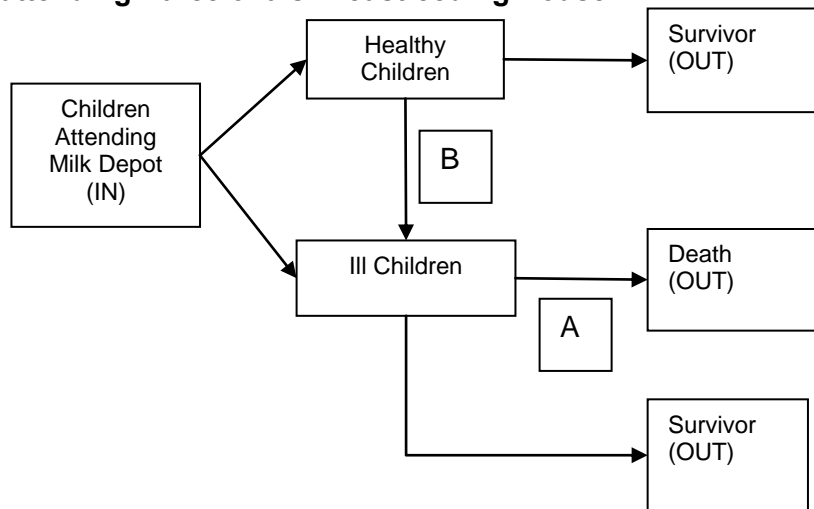
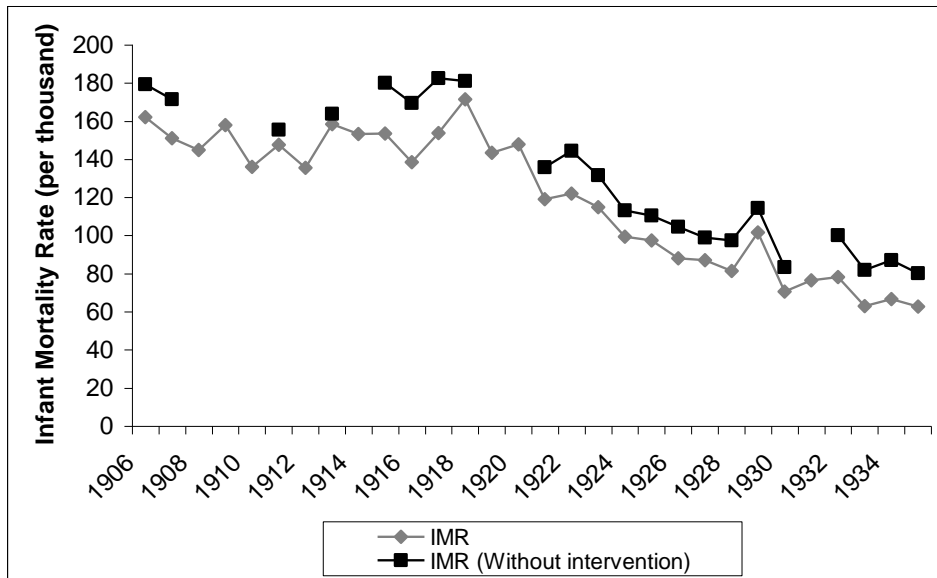


Figure 9
Barcelona (1906-1924): Infant Mortality Rates with or without Breastfeeding House intervention



Source: Barcelona's Statistical Yearbook and Barcelona's Official Journal

A comparison between an observed and an “estimated” infant mortality rate are shown in Table 10 (A) and Figure 9. Assuming that all ill children attending the Milk Depot died the main results are, first, that the average effect of improvement on the overall level of infant mortality in Barcelona between 1906 and 1935 induced by the Milk Depot was around a 15 percent. Second, that this effect did not follow an increasing trend. Between 1910 and 1919, that difference was around a 4 percent, and the improvement was remarkable in the last six year period (1930-35), when this difference reached 26 percent.

The lack of data on the number of children that changed their initial status of good health to illness, forces us to accept some values by way of guesses. These values are the rates of incidence of sickness for all kinds of digestive tract diseases computed for the children attending the Milk Depot with the total number of births in the population of Barcelona. This epidemiological parameter fluctuates between 5 and 10 percent throughout the period studied here. Results of this last simulation are also shown in Table 10 (sections B and C). These results show that, if this transition existed, there were no remarkable effects on final infant mortality levels. Mean increases in differences between observed and estimated rates are around 2.7 and 3.8 percent.

The largest proportion of children attending the Milk Depot had digestive tract diseases, on average about a 75 percent. Unfortunately, there is no information about causes of

death, but if we accept the assumption that all children were dying as a result of these kinds of diseases, the same kind of exercise can be repeated, now with the computation of infant mortality rates due to diarrhea and enteritis. In this second set of estimates (Table 11), the average effect between 1906 and 1935 reached 24 percent. As observed previously, the period 1930-35 shows the biggest improvement. These results suggest that the Milk Depot played a very active role in keeping mortality levels caused by these diseases low.

As mentioned previously, the Milk Depot in the Nursing House was not the only facility of this kind in Barcelona in the first third of the 20th century. The exercise of estimating its impact on infant mortality rates has only been carried out with the data from the Nursing House. However, this Milk Depot represented about 70 percent of all places offered to mothers in the city. In order to evaluate the total effect of this intervention, the participation of the other two Milk Depots must be taken into account (Table 12). Under the assumption that the number of sick and dead children in these two Milk Depots is equivalent to their proportion in all the places offered on a daily basis in Barcelona, it is possible to recalculate the new levels of infant mortality rates, as conducted previously (section (A) Table 10). As could be expected, there were differences between an observed and estimated IMR increase, in relation to previous results (Table 10 (A)). But these differences are slight (average of 18 percent now, 15 percent before). Obviously, these results reinforce the role played by these Milk Depots in the first half of the 1930's, because they suggest that this intervention keeps infant mortality levels around 34 percent lower than the likely levels achieved without this intervention.

Table 10
Evaluating the impact of the Barcelona's Milk Depot (Breastfeeding House) on Infant Mortality

Infant Mortality Rate (per thousand)	1906-09	1910-14	1915-19	1920-24	1925-29	1930-35	Change 1930/1910	Mean 1930/1910
A) Infant Mortality Rate (Observed)	153.91	146.35	152.01	113.75	91.21	69.79	-52.31	
Infant Mortality Rate (Estimated)	172.92	152.81	179.06	131.14	105.19	87.97	-42.43	
Difference Estimated-Observed (%)	12.35	4.41	17.79	15.28	15.33	20.05		15.20
B) Infant Mortality Rate (Estimated)	175.45	155.53	181.56	134.28	108.22	91.38	-41.25	
Difference Estimated-Observed (%)	13.99	6.28	19.44	18.04	18.65	30.93		17.89
C) Infant Mortality Rate (Estimated)	177.97	158.26	184.06	137.42	111.24	94.78	-40.11	
Difference Estimated-Observed (%)	15.63	8.14	21.08	20.80	21.96	35.81		19.05

(A) Assumption: All ill children attending Milk Depot die

(B) Assumption: Assumption (A) plus 5 percent of healthy children fall ill.

(C) Assumption: Assumption (A) plus 10 percent of healthy children fall ill.

Source: Barcelona's Statistical Yearbook 1906-1920. Barcelona's Official Journal 1917-1935.

Table 11
Evaluating the impact of the Barcelona' s Milk Depot (Breastfeeding House) on Infant Mortality from Diarrhea

Infant Mortality Rate (per thousand)	1906-09	1910-14	1915-19	1920-24	1925-29	1930-35	Change 1930/1910	Mean 1930/1910
IMR Diarrhea (Observed)	47.52	44.90	54.70	40.75	28.66	20.87	-53.52	
IMR Diarrhea (Estimated)	0,00	45.70	76.71	53.22	36.47	33.93	-25.76	
Difference Observ-Estimated (%)	0,00	1.78	40.23	30.60	27.24	62.55		32.48

Source: Barcelona's Statistical Yearbook 1906-1920. Barcelona's Official Journal 1917-1935.

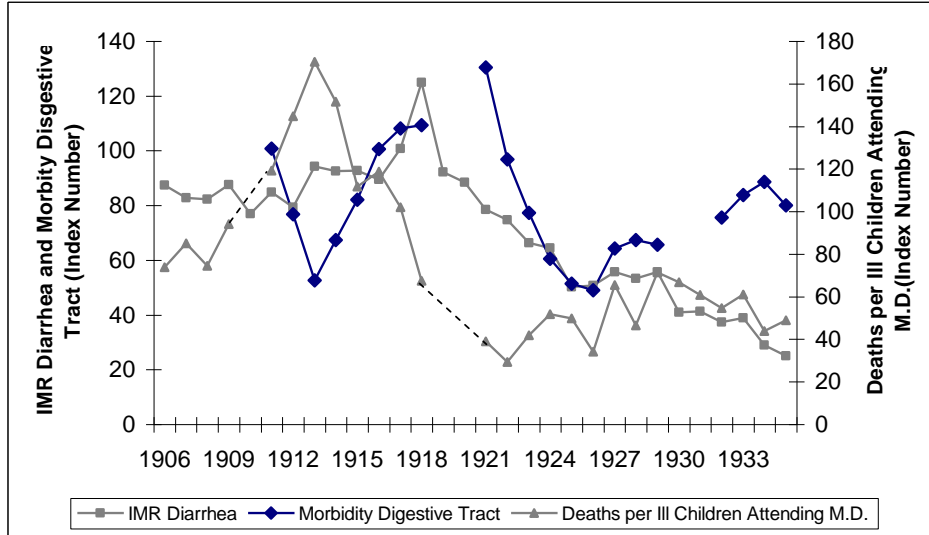
Table 12
Evaluating the impact on the Infant Mortality Rate of Barcelona's Milk Depots

Infant Mortality Rate (per thousand)	1906-09	1910-14	1915-19	1920-24	1925-29	1930-35	Change 1930/1910	Mean 1930/1910
Infant Mortality Rate (Observed)	153.91	146.35	152.01	113.75	91.21	69.79		
Infant Mortality Rate (Estimated)	174.82	153.45	181.77	132.88	106.59	89.79	-41.49	
Difference Observed-Estimated (%)	13.59	4.85	19.57	16.81	16.86	28.66		16.72

Source: Barcelona's Statistical Yearbook 1906-1920. Barcelona's Official Journal 1917-1935.

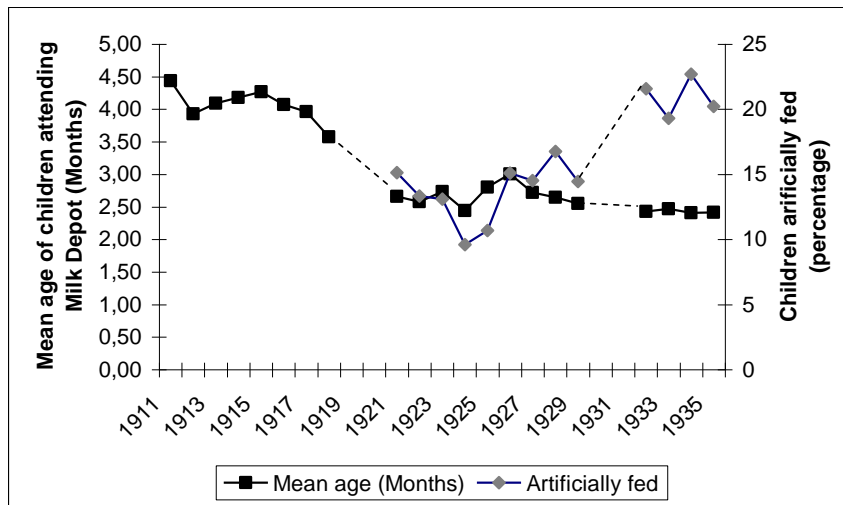
A full understanding of Barcelona's Nursing House dynamics is beyond the scope of these pages. However, in order to make some interpretation of all the previous results Figures 10 and 11 collect basic information about morbidity and mortality trends, and some other health characteristics of children attending the institution. Figure 10 combines the evolution of infant mortality rates from diarrhea and enteritis with morbidity and mortality indicators. This graphic allows us to understand the role played by this institution within the context of a drop in infant mortality rates in the city. In this sense, we can highlight the substantial improvements in the survival rates of the children admitted starting in 1916, anticipating a control over the overall mortality in the city as a whole that would still take years to arrive. The favorable results and overall functioning of the centre were stabilized in the first half of the 1920s. However, starting in the second half of this decade, while the city as a whole continued its irreversible drop in mortality, the Milk Depot came to deal with worse health conditions when a higher frequency of digestive illnesses was detected. Figure 11 shows how between 1915 and 1924 the mean age of children attending the institution declined by two months and the number of patients admitted fed solely artificially rose from 1924. Despite this, the increase in mortality rates among admitted patients was minimal, even the fatality rate decreased after 1929 (Figure 10). All these results suggest that the main role played by the Nursing House was increasingly selective over the years. A growing number of children at high levels of mortality risk were under medical control and, as the above-analyzed indicators have shown, the institution succeeded in the purpose of keeping the worst effects of some diseases related to feeding practices under control. From a chronological viewpoint the effect of the Milk Depot seems to be more crucial in the 1930s than in the 1910s or in the 1920s, when morbidity and mortality conditions were worse.

Figure 10
Barcelonas' s Milk Depot (Breastfeeding House) 1906-1935: Mortality and Morbidity Indicators
(Index Numbers 1915-19 =100)



Source: Barcelona Statistical Yearbook and Barcelona's Official Journal

Figure 11
Barcelona' s Milk Depot (Breastfeeding House) 1906-1935: Mean age of children attending
and proportion artificially fed



Source: Barcelona Statistical Yearbook and Barcelona's Official Journal

6. Conclusion

Many of the studies on Milk Depots in Spain have concentrated on the institutional factors and/or on the medical context behind them. This study, in contrast, has been specifically oriented towards the assessment of this healthcare initiative in terms of its impact on improving the infant survival rate. The evaluation of the Milk Depot's activities has focused on three dimensions: resources, processes

and outcomes. Milk Depots in Spain were basically local initiatives organized by the municipalities or by charitable institutions. It seems that these initiatives were strongly related to a kind of biomedical “critical-mass” existing in some cities, and personal relationships between doctors interested in new medicine for children. A study of the statistical information available has enabled us to see that one of the main limitations faced by the Milk Depot movement in Spain was its low capacity to protect broad swaths of the infant population. The estimated percentages for the provincial capitals were low for the most part, under ten percent. Given the important proportion of the rural population of Spain during the first third of the 20th century, the upshot of this would have been a very low level of protection for newborns as a whole. An analysis of the scarce figures available for the population as a whole suggests that the existence of Milk Depots does not seem to have made a major impact on controlling the prevalence and lethal nature of one of the main illnesses attacking the digestive tract that affected children, namely diarrhea. If they had any effect, it seems to have been complementary or subsequent to the effects of other factors.

Given the fact that the site of this kind of intervention was cities, we studied the statistical figures from the Milk Depot in Barcelona’s Breastfeeding House, the larger institution of this kind in the city. Through these figures, we have explored the influence of this institution and have tried to assess its capacity to improve the welfare of the infant population in the city. With this purpose in mind, a “counterfactual” exercise has been addressed to estimate final infant mortality levels if all children attending Milk Depots and surviving had died. According to the results, their ultimate impact would have been, on average, modest. It is important to notice that this health intervention did not modify trends of mortality decline in the city. However, this institution helped to keep levels of lethality low, especially in the 1930s and in mortality caused by digestive track diseases. Unfortunately, the statistical information published does not allow us to see how the Milk Depots might have treated sectors of the breastfeeding population at a higher risk of contracting these diseases. If we assume that all families attending this center were poor, this intervention seems to have been more successful from a social viewpoint. However, if all the evidence collected here and the interpretation has been correct, they show that the basic sources of change in urban child mortality were beyond the positive effects of this health intervention.

REFERENCES

AGUILERA HERNANDEZ, I.M. and RODRÍGUEZ PÉREZ, M (2008) “La Gota de Leche onubense: La asistencia y el control del niños sano en la primera mitad del siglo XX”. *Híades. Revista de Historia de la Enfermería*, n 10, pp 465-475.

- ANAUT BRAVO, S (1998) *Cambio demográfico y mortalidad en Pamplona (1880-1935)*. Universidad Publica de Navarra. Pamplona
- APPEL, R.D (1987) *Mothers and Medicine; A social history of infant feeding 1890-1950*. The University of Wisconsin Press. Madison.
- ARBELO, A (1962) *La Mortalidad de la Infancia en España 1901-1950*. Consejo Superior de Investigaciones Científicas. Madrid
- ARNAVAT, A et alt. (1995) *L'Institut de Puericultura Dr. Frias. "La Gota de LLe" Reus 1919-1994*. Ajuntament. Reus. Reus.
- AYUNTAMIENTO DE MADRID (1929). *Información sobre la ciudad. Año 1929. Memoria*. Imprenta y Litografía Municipal.
- CAIN, L.P. and ROTELLA, E.J (2001) "Death and Spending: Urban Mortality and Municipal Expenditure on Sanitation" *Annales de Démographie Historique*, n 1, pp 139-154.
- CASELLI, G; MESLÉ, F; VALLIN, J. (1999) "Le triomphe de la médecine" en BARDET, JP et DUPÂQUIER, J. (Dir) *Histoire des Populations de l'Europe*, vol III, Fayard, Paris, pp. 125-181.
- CERRILLO RUBIO, M.I; IRUZUBIETA BARRAGAN, F.J. and FANDIÑO PEREZ, R.G. (2008) *Un Siglo de la Gota de Leche. Arquitectura, Sanidad y Juventud*. Gobierno de la Rioja. Instituto de Estudios Riojanos.
- CHAMIZO, C. (1999) *La Gota de Leche y la Escuela de Enfermeras*. Gijón. Gráficas Covadonga. 1999
- CUTLER, D and MILLER, G. (2005) "The Role of Public Health Improvements in Health Advances: The Twentieth-Century United States" *Demography*, vol 42, n.1, pp.1-22.
- FERGUSON, A ; WEAVER, L.T. and NICOLSON, M. (2006) "The Glasgow Corporation Milk Depot 1904-1910 and its role in Infant Welfare: An End or a Means?", *Social History of Medicine*, 19 (3) pp 443-460.
- GARCIA GARCIA (2003) *La Gota de Leche. Casa Cuna de Gijón*. Ayuntamiento de Gijón.
- GOMEZ REDONDO, R. (1992) *La mortalidad infantil española en el siglo XX*, Centro de Investigaciones Sociológicas, Madrid.
- HANDLER, A; ISSEL, M; TURNOCK, B (2001) "A Conceptual Framework to Measure Performance of the Public Health System" *American Journal of Public Health*, vol 91, n 8, 1235-1239.
- KHLAT, M (Ed) (1996) *Demographic Evaluation of Health Programmes*. CICRED-UNFPA. Paris.
- LEE, W.R. (Ed)(1979): *European Demography and Economic Growth*. London, McMillan.
- LEE, K-S. (2007) "Infant Mortality Decline in the late 19th and early 20th century: Role of Market Milk". *Perspectives in Biology and Medicine*, vol 50, n 4, pp 585-602.
- LOSTE, L (1933) "El Instituto Nipiológico de Huesca", *La Medicina de los Niños*, Enero, pp.
- MAJAN GIL, N (1990) *La Protección a la Infancia en España a través de la Obra de Rafael Ulecia y Cardona y de los Consultorios de Niños y Gotas de Leche*. Universidad Complutense de Madrid. Madrid
- MOTILLA, X and SUREDA, B (2008) *La gota de LLe. Protecció a la Infancia i Educació social a la Menorca contemporània*. Institut Menorquí d'Estudis. Menorca.
- PASCUA, M (1934) *La mortalidad infantil en España*. Madrid. Departamento de Estadísticas Sanitarias de la Dirección General de Sanidad.
- PERDIGUERO-GUL, E. and BERNABEU-MESTRE, J (1999) "La Gota de Leche de Alicante (1925-1940)" in BENITO LLORIS, A; BLAY MESEGUER, F and LLORET PASTOR, J (Ed) *Beneficència i Sanitat en els municipis valencians*.

Seminari d'Estudis sobre Ciència, Associació Cultural Alcoià-Comtat, Centre Alcoià d'Estudis Històrics i Arqueològics. Alcoi. Pp 291-310.

PERDIGUERO-GUL, E. and BERNABEU-MESTRE, J (2005) "Child Care in Urban and Rural Alicante: the Gota de Leche", in BARONA, J.L and CHERRY, S. (Ed) *Health and Medicine in Rural Europe (1850-1945)* pp 347-359.

RASHAD, H.,GRAY, R; BOERMA, T (Ed) (1995) *Evaluation of the Impact of Health Interventions*. IUSSP. Liège

RECHE ANDRES, J (1981) *La Pediatría Española a través de la revista "La Medicina de los niños" 1900-1936*. Madrid. Universidad Complutense de Madrid

RODRIGUEZ OCAÑA, E; ORTIZ GOMEZ, T.; GARCIA-DUARTE ROS, O. (1985) "Los consultorios de lactantes y gotas de leche en España", *Jano*, XXIX , p 1066-72.

RODRIGUEZ OCAÑA, E. (1996) "Una medicina para la infancia" in BORRAS LLOP, J.M (Dir) *Historia de la infancia en la España contemporánea 1834-1936*. Ministerio de Trabajo y Asuntos Sociales. Fundación Germán Sánchez Ruipérez. Madrid, pp 149-169.

RODRIGUEZ OCAÑA, E(1999) "La construcción de la salud infantil. Ciencia, medicina y educación en la transición sanitaria en España", *Historia Contemporánea*, nº 18, pp.

RODRÍGUEZ OCAÑA, E. and PERDIGUERO, E (2006) " Ciencia y persuasión social en la medicalización de la infancia en España siglos XIX-XX", *Historia, Ciencias, Saúde, Maguinhos*, vol 13, abr-jun, n.2, pp 303-324.

ROLLET-ECHALIER, C (1990) *La Politique à l'égard de la petite enfance sous la IIIe République*. PUF, Paris

ROLLET-ECHALIER, C. (1995) "The Fight Against Infant Mortality in the Past: An International Comparison " in BIDEAU, A.; DESJARDINS, B and PÉREZ BRIGNOLI, H. (Ed) *Infant and Child Mortality in the Past*. Oxford University Press. Oxford. Pp 38-60 .

ROLLET, C(2001) "La santé et la protection de l'enfant vues à travers les congrès internationaux (1880-1920) « *Annales de Démographie Historique*, n 1, pp 97-116

RYCHETNICK, L; FROMMER, M, HAWE, O; SHIELL, A (2002) "Criteria for evaluating evidence on public health interventions" *Journal of Epidemiology and Community Health*, 56, 2, pp 119-127.

SZRETER, S. (2005) "The Importance of Social Intervention in Britain's Mortality Decline c. 1850-1914. A Reinterpretation of the Role of Public Health" , *Health and Wealth. Studies in History and Policy*. University of Rochester Press. New York pp. 98-145.

Annex 1

Milk Depots in Spain before 1915

Nº	Year of Foundation	Another Year of Reference	Locality	Provincial Capital	Population Census 1910	Kind of Insitution
1	1880		Barcelona			Municipality
2	1890		Barcelona	Yes	587,411	Charitable Institution (private)
3	1903		Bilbao	Yes	93,536	Board of Charitable Institutions
4	1903		San Sebastián	Yes	49,008	Social Welfare (Savings Bank)
5	1904		Logroño	Yes	23,926	Municipality
6	1904		Madrid	Yes	599,807	Charitable Institution (private)
7	1905		Talavera Reina		12,357	n/a
8	1906		Mahon		17,542	Charitable Institution (private)
9	1906		Jaca		5,202	n/a
10	1906		Madrid			Depending on Foundling Hospital
11	1906		Sevilla	Yes	158,287	Charitable Institution (private)
12	1906		Málaga	Yes	136,365	Board of Charitable Organizations
13	1907		Palma Mallorca	Yes	67,544	n/a
14	1907		Madrid			Municipality
15	1907		Zaragoza	Yes	111,704	Charitable Institution (private)
16	1908		Salamanca	Yes	29,830	Municipality
17	1909		Cartagena		102,542	Local Child Protection Board
18	1910		Utrera		15,460	n/a
19	1910		Valencia	Yes	233,348	Municipality
20	1910		Valladolid	Yes	71,066	Municipality
21	1910		Arjona		7,379	n/a
21	1911		Guadalajara	Yes	12,176	n/a
22		1911	Santander	Yes	65,046	n/a
23	1912		Orense	Yes	15,908	Pulic Organization (¿?)
24	1912		La Coruña	Yes	47,984	Local Child Protection Board
25		1912-15	Vitoria	Yes	32,893	Municipality
26		1912-15	Burgos	Yes	31,489	Charitable Institution (private)
27		1912-15	Jaén	Yes	29,217	Charitable Institution (private)
28		1912-15	Oviedo	Yes	53,269	n/a
29		1913	Murcia	Yes	125,057	n/a
30		1913	Huesca	Yes	12,419	n/a
31		1914	Cádiz	Yes	67,174	n/a
32	1915	1915	Vigo		41,213	Local Child Protection Board