Child Mortality and Causes-of-death in Madrid, 1905-1928

Inequalities Across the Urban Environment During the Epidemiological Transition

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In early 20th century Madrid, child mortality was as high as infant mortality, a pattern frequently observed in Mediterranean settings (Figure 1). The capital of Spain was moreover a particularly dangerous place, nicknamed by contemporary hygienists and journalists the "city of death" (Revenga, 1903; Oris et al., 2024). From 1913-15, child mortality started to decline while infant mortality followed later and more slowly. Our data covers this important chapter of the epidemiological and mortality transitions which has frequently been studied with aggregate figures, but rarely with nominal individual data.

Figure 1. Infant and child mortality in Madrid, 1900-1960

The first aim of this paper is to identify the causes of death that led the decline, but also the persistent ones, that have been less considered in the existing studies. For that purpose, we use a new international classification of causes of death that will ensure comparability of our results with those obtained in other urban settings. While in the pre-transitional phase cities were quite unsafe places, they pioneered the epidemiological and mortality transitions, and although many explanations have been proposed, there is no consensus on a single one. That is why our second

aim is to go back to the basis, and consider the urban environment, both in terms of social stratification of a segregated urban space and of vulnerabilities to the climatic hazards, two dimensions that are interrelated and subject to change during the studied period. Child mortality ($_1q_4$) is especially interesting in that perspective since well-known as one of the best indicators of development.

In this research, we use the Madrid birth and death certificates for the crucial and under-studied period 1905-1928. Specifically, birth information was acquired from the Civil Register of the city, as well as the death information for a total amount of 340'000 death events, including 104'000 deaths of children under five years of age. The death certificates have been linked with the birth certificates using record linkage techniques based on a probabilistic approach. Due to the quality of the data and the large amount of information in the sources, especially the Spanish custom of carrying two surnames, is a great help in making linkages and ensuring their validity. We have found the birth certificates of 95% of the children who died under the age of 5. Biases due to migrations are reduced first because we cover all the city of Madrid, so that internal moves do not impact the reconstruction of child biographies, and families with young children were less inclined to out-migration; but we continue to work on the remaining 5% to better understand how they were. The resulting massive database already allows to analyze in detail mortality until the fifth birthday

Madrid's birth certificates are very informative. For each individual, the following information is recorded: date of birth, name (or names), two surnames for each parent, sex, place of birth within the city (district, street and number), province of birth of parents and a note that includes information on the nature of birth, such as the case of twins. A major limitation, however, is the absence of an indication of the occupation of the parents. The death certificate, on the one hand, is limited to information about the deceased individual, including date of death, name (or names), names of the parents, age at death (expressed in years, months and days) and the place of death in Madrid, the latter with a structure compatible with that of the birth certificate (district, street and number). On the other hand, a very special feature of death certificates is the systematic mention of the cause of death for each deceased individual in the city. Causes of death were coded using the method proposed by Bernabeu-Mestre et al. (2003), which aims to classify historical diagnostic expressions (See Figure 2).

At the time of this submission, we are working on a grid of conversion with a classification named CHILDCAT. This is part of a long-term project which has constructed ICD10h, a classification of historic causes of death which is based on the International Classification of Diseases, 10th Revision (ICD-10) (WHO 2016). CHILDCAT specifically targets the causes of death between the ages of 1 and 5. On that basis, we analyze systematically the causes of child mortality and their evolution, sometimes confronting the old and the new classifications. Our first results already show that water- and food-born infectious diseases declined rapidly while the airborne infectious diseases were persistent. We also identify causes of death that reflect acute syndromes of malnutrition, reflecting the prevalence of poverty in Madrid during the first third of the 20th century.

To better understand divergent evolutions, we use semi-parametric Fine-Gray models for competitive risks. For the main groups of causes of death and for a few specific ones, we test the impact on child survival of the embeddedness of social inequalities and urban space and of climatic hazards.

Indeed, mortality and epidemiological transitions were not the only ones that Madrid experimented during this period. Between 1900 and the Civil War (1936), the city center gained the attributes and appearance of a modern capital after important investments were made in public hygiene, the construction of new buildings, the development of national administrative entities, educational facilities, and business and shopping districts. Conversely, living conditions were extremely poor in peripheral areas. Progress was associated with growing differences between neighborhoods where inhabitants accumulated advantages and the areas the contemporaries called "barrios negros" or "barrios bajos", which accumulated disadvantages. Social stratification and spatial segregation characterized Madrid's urban environment and heavily affected the inhabitants' relationships with life and death. It was especially true for children aged 1 to 4, which are known to be particularly vulnerable to external influences. Among those influences are the climatic hazards, specifically the episodes of heatwaves and cold spells. The formers are especially aggressive in an urban environment and in epidemiological terms, have a clear relationship with water-and-food borne diseases. The latter are related to airborne diseases and are particularly threatening in dense urban areas with poor lodging conditions. Malnutrition fragilizes the immune system, whatever the disease.

We measure all those interactions to provide a better understanding of the rapid mortality decline and changes in the epidemiological environment, which were largely unexpected.
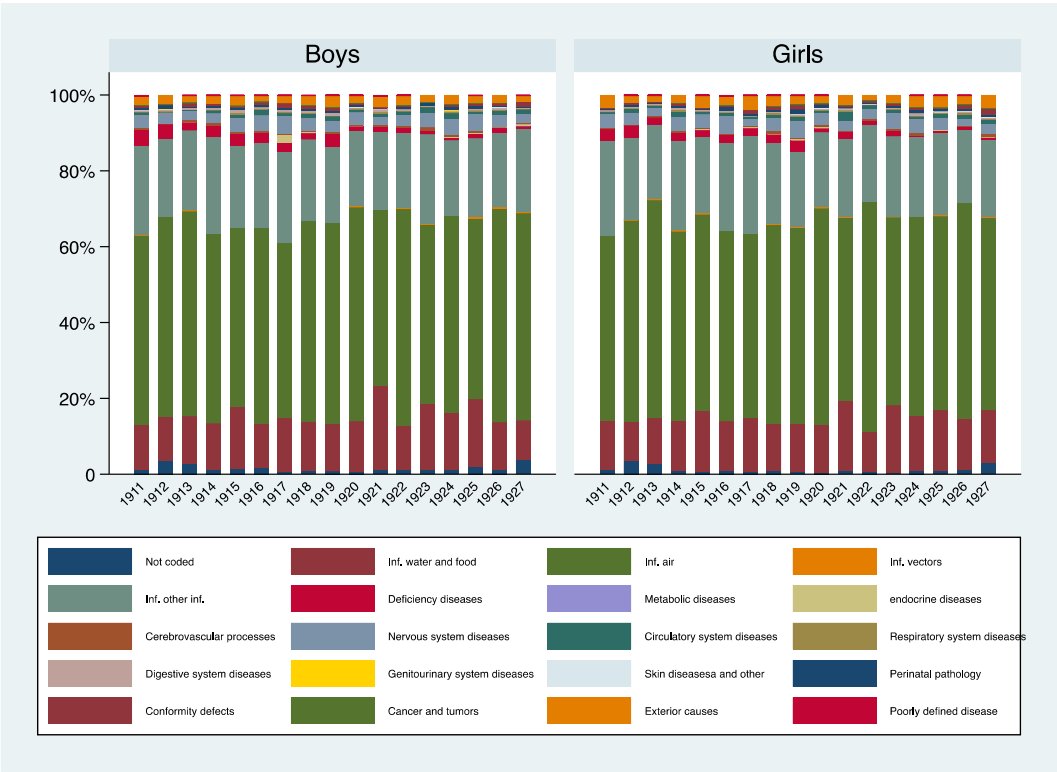

Figure 2. Distribution of causes of death in the age group 1-4, by sex