Individual-Level Data on Causes of Death in Madrid From 1905 to 1927

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To cite this article: Ramiro Fariñas, D., Mazzoni, S., Bourguignon, M., Villuendas Hijosa, B., & Oris, M. (2026). Individual-Level Data on Causes of Death in Madrid From 1905 to 1927. *Historical Life Course Studies, 16*, 74–86. https://doi.org/10.52024/hlcs25002

HISTORICAL LIFE COURSE STUDIES

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Sources and Databases on Individual-Level Causes of Death in Historical Societies (1800–1950)

VOLUME 16, SPECIAL ISSUE 8

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HISTORICAL LIFE COURSE STUDIES
VOLUME 16 (2026), 74–86, published 07-04-2026

Individual-Level Data on Causes of Death in Madrid From 1905 to 1927

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ABSTRACT

In this article, we present the Madrid database on causes of death, which currently covers the entire city for the period 1905–1927 and includes 366,542 individual notices. Such a resource is unique in the Mediterranean context. The genesis of our data lies in a political and intellectual context dominated by a complex mixture of fears, class contempt, and sincere concern for the most vulnerable, especially children, which explain the development of social and health data and the widespread use of quantitative methods in early 20th-century Spain, particularly in its capital. This resulted in the sources which, over the last 20 years, have been patiently compiled to construct the database of causes of death. The original data were enriched by linking individual data and coding operations, particularly for causes of death, for which two different grids were used. This article questions the quality and reliability of causes of death, that were extraordinarily diverse (n = 1,444). We also summarize the work already accomplished and outline some avenues for future research.

Keywords: Causes of death, Madrid, ICD10h

e-ISSN: 2352-6343
DOI article: https://doi.org/10.52024/hlcs25002

1 NATIONAL AND LOCAL CONTEXTS FOR THE DEVELOPMENT OF STATISTICS ON CAUSES OF DEATH

At the beginning of the 20th century, Spain experienced a development in social medicine that was similar in many ways to that observed in many other European countries, but with certain distinctive features. The upper classes considered the country to be backward and in crisis. They developed a modernization project that included concern for health in a society undergoing urbanization and industrialization (Otero-Carvajal & de Miguel Salanova, 2021). This interest was reinforced by the spread of Darwinism and eugenics, which fueled fears of racial degeneration (Marín & Huertas, 2001; Nash, 1992), particularly among the poor populations of slums, living in overcrowded and unsanitary areas considered immediate threats because they were seen as breeding grounds for contagious diseases (Manzano Gómez, 2022). As a result, an important element of Spanish social medicine was the development of a social and moral etiology of disease focused on lifestyles (alcoholism, sexual behavior) and the unsanitary conditions of housing, streets, and neighborhoods (Rodriguez-Ocaña, 1987). A typical and well-known example is the study by Dr. Philippe Hauser (1902) on "Madrid from a medical and social point of view".

Another aspect of Spanish social medicine, even more relevant to our discussion, was the introduction of quantitative methods (Bernabeu-Mestre, 2007; Matthews, 2006; Rodriguez-Ocaña & Bernabeu-Mestre, 1996). Statistics on mortality and causes of death, particularly evidence of the high prevalence of infectious diseases, were widely used as a communication tool to gain public support for prevention and encourage behavioral changes in hygiene (Rodriguez-Ocaña & Bernabeu-Mestre, 1996). This was also a fight against fatalism, particularly regarding childhood diseases, as since the microbiological "revolution" of the 1880s, infectious diseases were increasingly less perceived as inevitable. The development of bacteriology played an important role in strengthening confidence in a "new" medicine and its prestige (Rodriguez-Ocaña, 2007). The question of the power of statistics also emerged to push authorities to invest in public health infrastructure (Casado Ruiz, 2021). Ultimately, statistics had to demonstrate the success of national regeneration by measuring the decline in mortality, particularly among children, the future of the nation, and the reduction in emblematic causes of death, such as tuberculosis.

This was particularly important in Madrid, because the capital had been assigned the role of spearheading the national modernization project, and it was a formidable challenge. In 1905, life expectancy was only 28 years, particularly due to high infant and child mortality and the high prevalence of tuberculosis. It is important to note that contemporaries were aware of this: Madrid was nicknamed the "city of death" (Pulido-Fernández, 1891; Revenga, 1901; Ruiz-Berdún, 2014). This expression was regularly used in daily newspapers, generally to challenge the municipal authorities and denounce scandalous situations such as the spread of contagious diseases or the sale of adulterated milk (Oris et al., 2024). Regardless of the debates, the municipality of Madrid was concerned. As we will show, the local administration compiled its own detailed annual statistics on mortality and causes of death. These proved to be a gold mine for social medicine practitioners, for example for Álvarez y Rodríguez-Villamil's (1912) study on tuberculosis in the city of Madrid.

2 DESCRIPTION OF THE SOURCE

In Spain, the recording of causes of death dates back to 1838 (Ramiro-Fariñas, 1998) as part of the first attempts to create a civil registry system, which was then based on parish records of births, marriages, and deaths. From 1871 onwards, a medical certificate specifying the cause of death was required (Pujadas-Mora, 2024, p. 85). This new rule was part of a broader reform: from that year onwards, civil registration of births, marriages, and deaths replaced parish registers. A certificate had to be completed within two days of the death.[1] This source follows a classic format, similar to that of other European countries, with a narrative section and mandatory fields, including the cause of death. At the national level, Spanish statisticians recommend treating causes of death with caution until the beginning of the 20th century (Gómez Redondo et al., 2023).

1 This delay was almost always respected in Madrid.

Madrid was specific, among others because the statistical service of the City Council took an original initiative. The basic information from the original civil registers were transcribed into large rectangular tables, one for each year and for each of the city's 10 districts. In these documents, kept in the municipal archives, each deceased person was assigned a registration number, consecutive up to the last death recorded that year in the district. With one line per deceased person, the columns indicate the first name and two surnames, age at the time of death (in years, or months or days for infants), the municipality and province of the deceased's place of birth, marital status and occupation (usually absent for deceased children), date of death, home address (house number, street, neighborhood), the cause of death, the cemetery where the deceased was buried. A last column is devoted to any important observations such as the names of the parents when the deceased was a child, as well as the place of death if it did not occur at home (in a hospital, other health care facility, etc.), and also information about a possible so-called "judicial" procedure, which we will explain further on. The structure of the variables in these municipal registers remained unchanged throughout our study period.

In principle, until 1975, civil registries covered *de facto* deaths and births, i.e., those occurring within the territory of Madrid (Gómez Redondo et al., 2023, p. 2).[2] This means that all deaths occurring in the city's institutions were also included. This concerned La Inclusa foundling hospital, where abandoned children often had mothers from outside Madrid (Revuelta-Eugercios, 2013), the maternity hospital, where 81% of women giving birth were single mothers (Gonzáles-Esteban et al., 2025), and the provincial hospital. This has important implications for estimating all-cause and specific-cause mortality (Revuelta-Eugercios & Ramiro Fariñas, 2016).

Another issue is that in Spain, until 1975, babies who died within the first 24 hours of life were considered as "aborted creatures" and recorded in special registers (named in Spanish *legajos de Abortos* or more rarely *Cuadernos de Fetos*), which had to be destroyed after a certain time (Pujadas-Mora, 2009, p. 103; Ramiro Fariñas, 1998). As these documents have disappeared or are inaccessible, these newborns are absent from our birth and death databases, which poses a significant problem, as the first 24 hours of life were decisive for a child's survival. The resulting underestimation of infant mortality has been estimated at around 10% for Spain as a whole, around 8% in rural areas, and around 12% in large cities such as Madrid (Dopico & Reher, 1998). In terms of causes of death, this gap limits our epidemiological knowledge of neonatal mortality and restricts our ability to study maternal mortality (although indirect approaches are possible, using causes of death; see Gonzáles-Esteban et al. (2025)).

3 DATABASE DEVELOPMENT: CONSTRUCTION AND DESCRIPTION

In 2005, under the leadership of Diego Ramiro Fariñas, the digitization of rectangular tables began.[3] The data was extracted from approximately 6 million images that our department first digitized from existing microfilms provided by the municipal archives of the city of Madrid. The information was manually entered into Excel files, transcribing literally every piece of information appearing in the images (see Figures 1 and 2). The only differences are that accents and capital letters were omitted in order to simplify the linkages of nominal data. Most of this work was done by a technician from our department, specialized in this task (and coauthor of this paper). Many students doing an internship also contributed. A 20-year effort has resulted in the possibility of covering the entire period from 1905 to 1927, a goal that has been achieved in 2025. Burials data from 1888 to 1899 have also been collected, but the codification of causes of death is still ongoing, and we work on the very first years of the 20th century. The ambition is to cover the entire period 1888–1935, which saw the epidemiological transition profoundly transform the urban epidemiological landscape.

2 However, our data also include a few *de jure* deaths of Madrid residents who disappeared at sea or died during the wars in North Africa.

3 Two other large databases, not described here, were created in 2005. One concerns the Madrid Foundling Hospital and reconstructs the life stories of 60,000 abandoned children in Madrid, and the other is the Madrid burial register from 1888 to 1901, which contains basic information on every person buried in the city, including fetuses, with information on surname, first names, gender, age, postal address, and marital status. This second database includes approximately 250,000 additional death records.

Figure 1 *Example of Madrid rectangular table; district Audiencia in 1901*

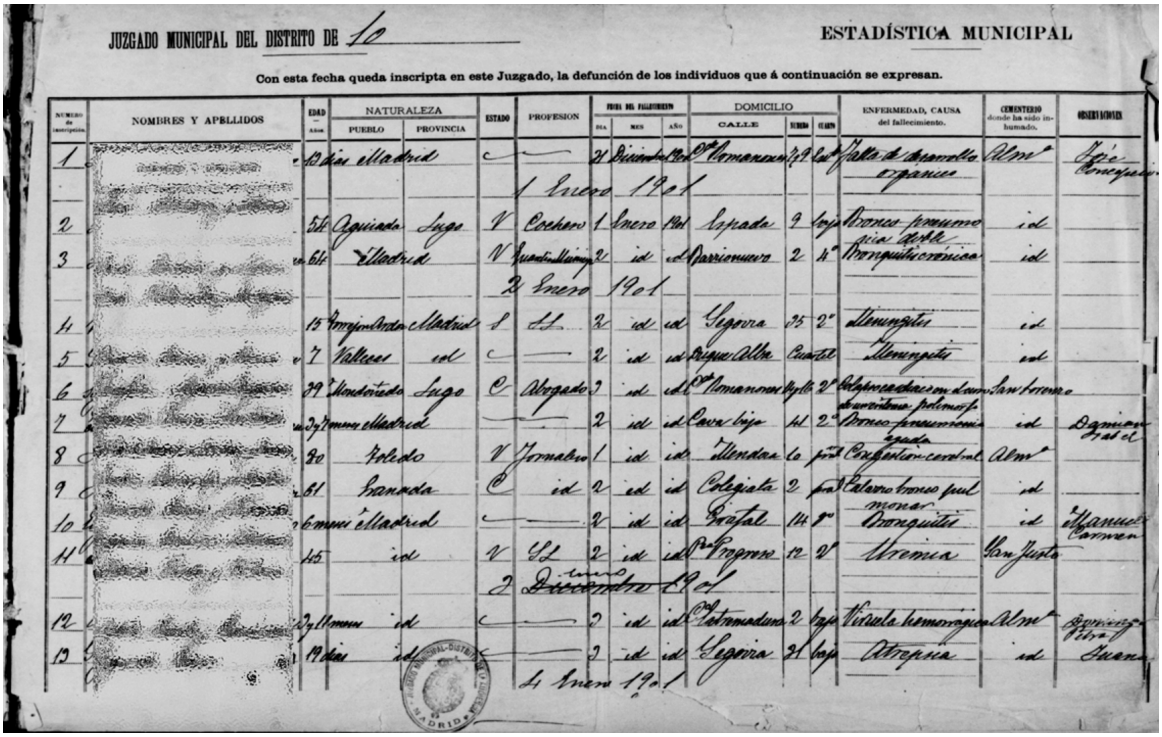
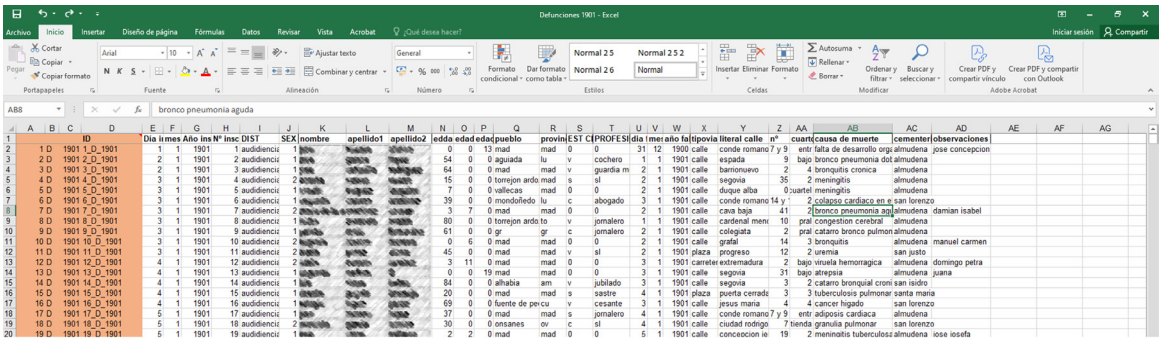


Figure 2 *Introduction of the variables in the database*



Note: Data corresponding to the previous image.

The 1905–1927 database is in Stata format, and most data management operations are performed using this software. We linked deaths and births in order to reconstruct the life history of young children and link them to their parents. A preparation phase included coding or standardization, in particular the use of phonetic algorithms for surnames and first names.[4] We then adopted a probabilistic approach to link records (Fellegi & Sunter, 1969), using the Dtalink module (Kranker, 2018). We identified the birth certificates of 94% of children who died in Madrid before their fifth birthday, or 95% if only infant deaths are considered. Third, a deduplication process, also based on a probabilistic approach, was used to identify births from the same mother and father (Oris et al., 2023). Fourth, we searched for the death certificates of the parent(s) in order to study the impact of orphanhood on child survival and to analyze maternal mortality (Gonzáles-Esteban et al., 2025). Overall, our results, corroborated by other research on length of residence in the city, suggest a contrast between the intense mobility of young, single adults, who were numerous but generally in good health, and the settlement of families (Ramiro-Fariñas et al., 2021). Combined with the high mortality of infants born in institutions, this helps explain the high rates of linkages for children.

An important feature of our database is the systematic recording of the cause of death. For the period 1905–1927, 25,093 unique strings were observed. This diversity of strings reflects the multiple transcriptions of medical diagnoses, first by the certifying physician, then by the civil servant who wrote the death certificate, then by the municipal clerk who compiled the rectangular tables, and

4 In particular, we used the SOUNDEX and NYSIIS algorithms (Vykhovanets et al., 2020).

finally by our team when entering the data into Excel. Errors (such as typos) could occur at each stage, compounded by the complexity of medical vocabulary. In addition, no less than 37.7% of the strings included a secondary cause of death.[5]

Coding causes of death is a long-standing challenge (Alter & Carmichael, 1996, 1997, 1999). For the Madrid database, we used two coding systems. The first, proposed around 2003 by a group of Spanish medical historians and historical demographers (Bernabeu-Mestre et al., 2003; Ramiro Fariñas et al., 2002), has been widely applied in studies of mortality in the Iberian Peninsula, and beyond (Revuelta-Eugercios et al., 2022). It is based on two principles: following McKeown's (1976) suggestion, it distinguishes between contagious and non-contagious diseases according to medical knowledge in the early 2000s; within these two broad groups, it applies Bertillon's classification (1899) used by the Spanish Geographic and Statistical Institute for the production and publication of aggregate statistics on causes of death (Gómez Redondo et al., 2023; Pérez-Moreda et al., 2015, pp. 81–87). The second scheme is a more recent adaptation to historical research of the 10th version of the World Health Organization's International Classification of Causes of Death (WHO, 2004). Originally developed as part of a collective project on port cities (Janssens & Devos, 2022), ICD-10h is being further expanded as part of the COST Action project "The Great Leap. Multidisciplinary approaches to health inequalities, 1800-2022" (Reid et al., 2024a, 2024b). The latter has been applied to our data because it aims to provide an analytical and comparative framework between countries over more than two centuries of rapid evolution in medical knowledge.

Currently, the database, enriched with the aforementioned links and codes, covers 366,542 death records. This database can be used for collaborative (comparative) research.

4 QUALITY AND RELIABILITY OF CAUSES OF DEATH

A first indicator of the quality of the causes of death reported in the Madrid data source from 1905 to 1927 is that certification problems affected only 0.24% of cases (n = 829). More specifically, the cause of death field was empty for 802 deaths; the others concerned people who had "disappeared" in Morocco (or more broadly in Africa) or at sea (shipwreck). The cause was explicitly reported as unknown in 695 cases (0.19%). The term "sin" (without) was the most frequent in this group, but the terms "unknown" or "not declared" (*no consta*) were also used, albeit rarely. Natural death, without any additional information, appeared in only 11 cases.

Another indicator is the limited importance of the group of ill-defined causes of death, which represents only 2.18%. This ill-defined characterization is clear when considering cases of fever (444 deaths), a symptom that is too vague.[6] More common, eclampsia (4,935 deaths, 1.35% of deaths) is another ill-defined cause that has recently been the subject of a comparative study in four European cities. Wienholts and colleagues (2025) observe its use for a wide variety of pathological processes. At the beginning of the 20th century in Madrid, cases were concentrated in infant (n = 2,958) and child (n = 1,549) mortality, as well as in disadvantaged neighborhoods in the north and south of the city, where doctors were confronted with matrons whom mothers often consulted for their children's digestive problems. This suggests a link with diarrhea and other gastrointestinal diseases, which has also been observed elsewhere (Murkens et al., 2023). The systematic use of the Latin term "eclampsia" in the causes of death reported by doctors[7] also points in this direction, suggesting a confrontation between elite medicine and folk medicine (Perdiguero-Gil, 1993; Perdiguero-Gil & Bernabeu-Mestre, 1995).

Another group, that of undetermined causes (coded R99.000 in ICD-10h, n = 433, or 0.12% of deaths), includes 221 strings that we were unable to associate with a known disease. We also have a few mentions that cannot be interpreted and therefore coded, such as "afecciones morales de la madre" (mother's moral affections), which could indicate postpartum depression, but also many other

5 We coded the first and second causes separately, simply in the order they appeared. An exception was made for children aged 1 to under 5 years, for whom, at the request of Tim Riswick and Michail Raftakis, when one of the two causes was a contagious disease, it was placed as the first.

6 References such as "fever," "consecutive fever," "inflammatory fever," and "intermittent fever."

7 The term "convulsiones" was only mentioned eight times.

things. We also found a few isolated mentions such as "aguda" (acute) or "ataques muy fuertes" (very strong attacks), which are too vague.

A fourth group is the "old age" category of ICD-10h, with 2.08% of all deaths, including 6.46% among those over 55. Mentions of "senectud" and "senilidad" (senility) accounted for 7,623 deaths. These are only problematic if the objective is to identify one or more specific diseases as the cause(s) of death. However, they largely reflected a reality, that of dying because one is old and reaching the end of one's life (Foster et al., 2001; Mansfield, 2001; Reid et al., 2015).

Overall, problematic situations or lack of information are very rare. The transition from causes of death based on symptoms to causes specifying medically well-identified diseases was observed in another Spanish city during the 19th century (Pujadas-Mora & Perdiguero-Gil, 2025). By the early 20th century in Madrid, this transition appears to have been largely completed. This is a first demonstration of the comprehensiveness of medical coverage of deaths in Madrid in the early 20th century. The diversity of diagnoses must also be taken into account. Among the 25,093 different versions of the causes of death reported, following Beemer (2009) and Pujadas-Mora and Perdiguero-Gil (2025), we counted the words in order to estimate the accuracy of these reports on causes of death. Conciseness was the dominant mode. In 40.8% of deaths, a single word was used, and two words in nearly half of the cases (49.5%). Among the latter, the most frequent combination associated a disease with a qualifier, "acute" and "chronic" being by far the most commonly used.[8] Among the 9.8% of mentions of causes of death comprising three or more words, dual or multiple causes became increasingly important. They were present in 3.61% of death certificates from 1905 to 1915, and in 6.4% for the following period (1906–1926).[9]

After the coding phase using ICD-10h, there remain 1,444 different causes of death, attesting to the extraordinary diversity of the epidemiological landscape of a large city in the first third of the 20th century.[10] This figure also reflects the encyclopedic knowledge of Madrid's doctors,[11] who imposed their scientific vocabulary on popular knowledge about diseases (Perdiguero-Gil, 1993). If we divide the number of deaths by the number of causes, it appears that the greatest diversity of diagnoses was observed between the ages of 5 and 14, and to a lesser extent between the ages of 15 and 39.[12]

Questioning the reliability of these diagnoses is a delicate exercise, which always carries the risk of anachronism. The historical context is important, particularly the state of medical knowledge and the training of doctors. From this perspective, the Madrid database on causes of death is clearly post-Pasteurian. In 1905, some twenty years after the fundamental discoveries of Koch and Pasteur, viruses were well known, and the infectious and contagious nature of many diseases was no longer in question. Furthermore, at that time, only the oldest doctors in Madrid had received their university training before the introduction of bacteriology into the medical curriculum; by 1927, all had been trained in the "new" medicine.

However, the question remains of the concealment of diseases that could damage the reputation of the deceased and their relatives. A relevant example is pulmonary tuberculosis, which was the most

8 About qualifiers, see Anderton and Leonard (2004) and Pujadas-Mora and Perdiguero-Gil (2025).

9 In the aggregated data published by the Spanish statistician, only one cause per death was taken into account. Bernabeu-Mestre (1993) discussed the negative consequences of this simplification for our understanding of the epidemiological landscape and the transition.

10 From 1902, the Bertillon (1899) classification, with 99 items of causes of death, was implemented in Spain and in Madrid. However, in our individual-level database, after codification with ICD-10h, we remain with 15 times more causes than at Bertillon. That is an indirect but quite clear demonstration that the Madrid physicians did not really pay attention to Bertillon list in their regular practice of causes of death reporting. This list was used, but only post, by statisticians, to reduce the diversity of the 1,444 causes of death to Bertillon's 99 and produce the aggregate statistics published by the Madrid municipality or the national statistics office. A new classification was not implemented by the Spanish statisticians until 1932.

11 Unfortunately, we have no information that would allow us to identify the physicians who certified the deaths and therefore cannot study the diversity of practices in this area.

12 However, this does not reflect the epidemiological reality: the 10 most common causes accounted for 71% of infant deaths, a proportion that decreased in the following age groups to 43.8% among those who died at age 55 and older, and between 64% among 1–4-year-olds, 51.1% among those aged 5–14, with a slight rebound to 56.1% among those aged 15–29, then 45.1% among those aged 30–54.

common cause of death in Madrid. Various sources report that doctors acted under pressure from families (Mitchell, 1990), but also for explicit medical reasons. Indeed, they considered pulmonary tuberculosis, bronchitis, and pneumonia to be more preventable than curable, and also believed that the latter two diseases were often the ultimate cause of death after a more or less prolonged period of tuberculosis morbidity (Miralles Buil, 2014, pp. 87–88). This confusion was particularly evident in times of crisis. During the three waves of Spanish flu, deaths from influenza were clearly underreported, as their number cannot explain the excess mortality observed, which was largely due to an increase in cases of pneumonia and bronchopneumonia (Cilek et al., 2018, p. 2512). The same was observed in Derbyshire (Reid, 2005, p. 32). These misdiagnoses may have been due to doctors' ignorance at the start of the pandemic or their reluctance to conduct thorough examinations of corpses in such circumstances. In Madrid, there was also an increase in deaths from tuberculosis during the flu waves. It can be suspected that the flu killed sick people and that doctors mentioned only one cause.

In terms of historical context, it is always important to consider the other aspect of the epidemiological transition, the emergence of chronic diseases. Historical demographers, and to a lesser extent medical historians, have emphasized the "Pasteurian revolution" (Gil Santos, 2022; Salomon-Bayet, 1986) in relation to the decline of infectious diseases. Vaccines and the successive introduction of sulfa drugs, penicillin, and antibiotics have been described as the main milestones (see, among many others, Mackenbach, 1996). This classic narrative has been challenged, but what interests us is that this approach has overshadowed other medical advances, particularly those related to cancer and surgery. In Spain, cancer mortality, initially one of the lowest in Europe, increased dramatically between 1900 and the 1990s (Mackenbach, 2020, p. 235), an increase that was largely real, but also partly due to advances in medical technology (Paeps et al., 2024). From 1905 to 1927, doctors in Madrid reported this cause of death with remarkable precision. They distinguished between cancer, carcinoma, epithelioma, sarcoma, neoplasia, fibromyoma, and generic "tumor," supplemented by the designation of more than 50 different organs or body parts that were affected. We count 2,515 strings for this single group of diseases. One example was "breast carcinoma undergoing surgery, followed by pulmonary embolism." Although the accuracy of cancer diagnoses did not reflect a dramatic improvement in treatments at the time, one exception was mastectomy (removal), discovered in the mid-19th century, which became widespread from the 1880s onwards as a solution to prevent the recurrence of breast cancer (Faguet, 2015). The use of this technique was part of a medical enthusiasm for surgery, in the construction of an image of surgical virtuosity worthy of admiration (Lawrence & Brown, 2016), which was based not only on the safety provided by antisepsis, but even more so on advances in anesthesia, which significantly reduced postoperative deaths (Eger et al., 2014; Zimmer, 2014).

This point is important in assessing the reliability of causes of death because, when coding the strings, we were surprised to find that doctors mentioned their failures. For example "uterine carcinoma operated on, then development of a peritoneal septic process" or "operative shock due to breast amputation." Thanks to this transparency, we are aware of procedures such as vaginal hysterectomy and laparotomy in cases of uterine cancer, etc., and know that some cancers were classified as "inoperable." Regardless of the disease being treated, the medical intervention was indicated, most likely by the physician who performed it, as the primary cause of death in 533 cases and as a secondary cause in an additional 82 cases. The most frequent mentions were postoperative anemia or hemorrhage, cardiac collapse due to surgery, postoperative peritonitis, and all other situations where the surgeon had overestimated his skills or the patient's state of health; but also postoperative bronchopneumonia, postoperative meningitis, and other infections, reminding us that hospitals were dangerous places (Casado Ruiz et al., 2021; Hauser, 1902; Ruiz-Berdún, 2024).

It is possible that this medical transparency regarding this type of cause was intended to avoid a legal procedure called "judicial". In case of doubt about a death, this procedure required the intervention of the authorities to establish the circumstances. What caused the doubt and who made the decision to initiate the procedure remain unclear, but some elements appear indirectly when we examine these cases. Between 1905 and 1927 in Madrid, 9,954 deaths (2.83% of the total) were classified as judicial, with 390 different causes of death reported. The largest group includes unspecified accidents, skull fractures, unspecified firearm discharges of undetermined intent, injuries, exposure to smoke, fire, and flames, and drownings, which together account for 2,169 deaths (21.8% of judicial deaths). For unknown reasons, a smaller number of deaths from these causes (279) were not subject to judicial proceedings. The latter also applied when the cause was reported as unknown or due to an unspecified event of undetermined intent (n = 753, 7.6%). However, the vast majority of judicial deaths had a

clear diagnosis indicating sudden death. The most common specific cause was cerebral hemorrhage (n = 696, 6.99%). In descending order of importance, there were also cardiac arrests, heart failure, heart disease (unspecified), and cerebral congestion. All had in common the suddenness of the event and its unexpected nature. However, the vast majority of deaths from these causes were not suspicious, and we do not know how the distinction was made between those that were considered judicial and those that were not. The same is true for various other diseases, such as the most frequent cause of death in Madrid at that time, pulmonary tuberculosis, with 309 judicial cases, representing only 1.1% of all deaths from this disease. From this brief overview, we can conclude that the vast majority of deaths due to external causes or unknown circumstances were investigated, as well as a small proportion of sudden deaths. Judicial investigations involved questioning doctors, which took time and encouraged them to provide clear information to the registry office.

5 RECENT RESEARCH USING THE INDIVIDUAL DATABASE

While several studies have been conducted on all-cause mortality in Madrid in the late 19th and early 20th centuries, research on epidemics has focused on specific diseases, namely the Russian flu of 1889–1890 and the three waves of the 1918–1920 global pandemic that struck Madrid. On these occasions, deaths from respiratory diseases were also analyzed due to the diagnostic confusion, particularly in times of crisis, that we previously mentioned. The main questions concerned excess mortality and its distribution by age, as well as reproduction rates. In the context of a large city like Madrid, which was undergoing chaotic growth at the time, the spatial distribution of epidemics was also a particular concern (Cilek, 2019; Cilek et al., 2018; García Ferrero, 2017; Ramiro-Fariñas et al., 2018). This dimension was central to the doctoral thesis of Casado Ruiz, who studied the impact on mortality, particularly deaths related to water and food, of water distribution and sewage systems, their modernization, and their expansion (Casado Ruiz, 2021; Casado Ruiz & Ramiro Fariñas, 2018; Casado Ruiz et al., 2021). This work demonstrated how, at least initially, public investment following epidemic episodes widened the gap between the affluent neighborhoods of modern, wealthy Madrid and the poor, under-equipped peripheral neighborhoods, particularly in the south and north of the city. The social segregation of urban space has remained a central theme in more recent research (Mazzoni et al., 2022). In the specific context of a capital city hardly hit by the 1918–1920 influenza pandemic, where infant and child mortality remained higher than in other major European cities for a long time, Madrid experienced both the best and worst of accelerated modernization during the first decades of the 20th century, with significant repercussions on its demographic and health transitions. These transitions cannot be understood without considering the evolution of the contribution of causes of death during a period that also saw the city move from excess mortality to under-mortality. Until now, analyses have focused on infant and child mortality, as the aforementioned linkages between death certificates and birth certificates allow for longitudinal and multivariate approaches. By studying mortality separately during the first month, between one and six months, between six months and one year, and between one and five years, the Iberian nosology (Ramiro Fariñas et al., 2002) was used to distinguish airborne-causes of death from water- and foodborne causes. Results showed profound spatial variations within the city, as well as under-mortality among children of migrant mothers (Oris et al., 2023). Another study highlighted the temporal dimension, specifically the impact of the economic situation and in particular milk prices, whose fluctuations had unexpected relationships with infant and child mortality due to water- and foodborne diseases (Oris et al., 2024).

Finally, ICD-10h was used. The analyses showed the contribution of airborne diseases, particularly meningitis, and to a lesser extent food- and waterborne diseases, to the overall reduction in child mortality in Madrid, although progress was hampered by housing and living conditions, as well as the poverty of a significant portion of the Madrid population. Positive factors included medical innovation (the post-Pasteur era, hospitalizations), food quality control, and hygiene movement. However, the seasonality of cause-specific mortality, still evident after the crisis years of 1917–1921, indicates that despite the diffusion of resources that led to the reduction in child mortality, a minority of the population remained unable to protect their children from spoiled food or cold weather, and contributed disproportionately to the number of child deaths (Oris et al., in press).

6 FUTURE RESEARCH

The Madrid database is far from having exhausted its research potential. Its size allows for the quantitative study of rare events, such as maternal mortality, using both causes of death and the classic definition of deaths within 60 days of childbirth, to compensate for the lack of information on babies who died within the first 24 hours of life (Gonzáles-Esteban et al., 2025). Although difficult, it is possible to study abortions, whether spontaneous, voluntary, or ambiguous. This will involve a kind of archaeological research into the relatively numerous traces of an important phenomenon at the crossroads of maternal health and birth control. The causes of death reflecting acute malnutrition also deserve to be studied in depth, in a city where mass poverty was still a reality, at least until the early 1920s (Oris et al., 2024; Pozzi et al., 2017). In that perspective, the dead bodies found in public spaces (streets, squares, parks), and who were not victims of violence, should also be considered carefully, as they were most likely the result of profound deprivation.

We also mentioned above an attempt to track mortality based on the 1905 census. Here again, the aim is to compensate for the lack of information: the absence of detailed data on the at-risk population for people aged 5 and over, and even for those under 5, the lack of information on parents' occupations.[13] This research focuses on the leading cause of mortality in Madrid, pulmonary tuberculosis. The initial promising results highlight the interaction between social classes and neighborhoods in Madrid, which was a highly segregated city. They also demonstrate the health advantage enjoyed by migrants and how this advantage diminishes with time spent in the city. From the end of the 19th century, alongside the development of social medicine, which we briefly mentioned at the beginning of this article, a heated debate took place between two schools of thought on the spread of tuberculosis in rapidly expanding urban areas: those who blamed poverty and wanted to reduce social inequalities, and those who emphasized the role of unsanitary hotspots and their dangerous populations and wanted to change the city (Miralles Buil, 2014; Fijalkow, 1998). Since we have the exact address of each deceased person and the cause of death, we can test the plausibility of the second interpretation by checking whether, between 1905 and 1927, tuberculosis was concentrated in specific locations. The methods developed for this purpose could be reused to study the spread of various infectious diseases in urban areas as they tended to decline, and to see at what point the breaking of chains of contagion contributed to this decline through an additive dynamic.

In the context of the epidemiological transition, the other facet, namely chronic diseases, also deserves our attention. We mentioned the case of cancer above, but heart and circulatory diseases have also been accurately reported by doctors in Madrid. In this regard, it seems that the age group for which the quality of diagnoses has improved the most, as it started from a low level, is that of the elderly. Here again, the database is large enough to allow for detailed analysis.

Finally, efforts are being made to acquire individual and family data from population censuses. Advances in optimal character recognition and artificial intelligence are opening a window of opportunity, a real possibility of realizing a scientific dream: the construction of a population register for a large city in southern Europe.

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13 The occupation of the person or parent (usually the father) is mentioned on death certificates, but not on birth certificates.

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