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RESEARCH ARTICLE

Tuberculosis in Early Twentieth-Century Hermoupolis, Greece

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Abstract

This article investigates tuberculosis mortality in Hermoupolis, the capital of the Greek island of Syros, during the period of continuous cause-of-death reporting from 1916 to 1940. Contemporary reports identified Greece as having one of the highest levels of tuberculosis mortality in Europe, with Hermoupolis ranking at the top within the country. In the early twentieth century, Greece launched an anti-tuberculosis campaign, primarily supported by philanthropists due to limited state intervention. The study examines the actions, if any, taken by the local authorities in Hermoupolis and analyzes mortality attributed to tuberculosis by age group and sex. The results reveal that tuberculosis mortality declined across all age groups in the 1930s, particularly among females. Deaths were concentrated in infancy, early adulthood (20–39 years), and the elderly. Clear differences in tuberculosis fatality rates among occupational classes were found, although they did not markedly differ from all-cause mortality patterns. Factors such as the lack of sanitary reforms, poor living standards, inadequate nutrition, and overcrowding could have potentially played key roles in the high tuberculosis mortality in the city. Considering the inefficacy of sanatorium treatment before the mid-1940s, it is plausible that improvements in factory working conditions and the decrease in industrial activity in the city may have contributed to the reduction in tuberculosis mortality in Hermoupolis during the 1930s.

Keywords: Tuberculosis mortality; age-specific mortality; causes of death; anti-tuberculosis campaign; modern Greece; Hermoupolis

Introduction

Tuberculosis is a highly contagious disease that poses a significant threat to global health, consistently ranking as one of the leading causes of illness and mortality worldwide. Before the emergence of the coronavirus (COVID-19) pandemic, tuberculosis held the grim distinction of being the primary cause of death attributable to a single infectious agent, surpassing even HIV/AIDS. Caused by the

bacterium *Mycobacterium tuberculosis*, the disease primarily affects the lungs, and it is transmitted through airborne droplets when individuals with pulmonary tuberculosis cough, sneeze, or spit. Even inhaling a small number of these infectious droplets can result in infection. Each year, approximately 10 million people contract tuberculosis. Despite being a preventable and treatable illness, it claims around 1.5 million lives annually. The burden of the diseases is disproportionately concentrated in low- and middle-income countries, particularly in Southeast Asia and Africa (World Health Organization 2022).

During the late nineteenth and early twentieth centuries, tuberculosis was not only one of the most significant diseases but also among the most intriguing. It was the leading cause of death across various life stages, particularly in young adulthood, and it profoundly shaped public health and societal transitions during this time. Known as the "White Plague," tuberculosis thrived in overcrowded urban environments characterized by poor living conditions, malnutrition, and inadequate hygiene. Its devastating impact prompted major advances, including Robert Koch's 1882 discovery of *Mycobacterium tuberculosis*, which redefined the disease as a communicable illness. Public health responses, such as the establishment of sanatoria and hygiene campaigns, marked the earliest efforts to control its spread. By the early twentieth century, tuberculosis mortality rates began to decline, driven due to improvements in nutrition, housing, and sanitation, even before the advent of antibiotics such as streptomycin in the 1940s. The introduction of the Bacillus Calmette-Guérin (BCG) vaccine and global control initiatives further transformed the fight against tuberculosis, aligning it with the broader health transition from infectious to chronic diseases. Nevertheless, tuberculosis's persistence in marginalized communities and the rise of drug-resistant strains underscore its ongoing challenges, making tuberculosis not just a historical disease but also a contemporary public health concern (Condrau and Worboys 2010).

The high level of tuberculosis mortality in the past has sparked debates over disparities in mortality and the factors that have contributed to its decline. These debates often focus on unresolved questions surrounding the influence of nutrition on resistance and the role of exposure in geographical, gender, and temporal variations in mortality. These contentious discussions sought also to determine whether nutritional factors played a crucial role in individuals' resistance to tuberculosis or if exposure to the bacteria mainly in the working and living environment was the primary determinant. For instance, McKeown (1976) attributed much of the decline in tuberculosis mortality to improved nutrition. Conversely, the 'bargaining-nutrition' hypothesis – linked to female inherent susceptibility, under-nourishment, and differences in exposure – has been proposed to explain higher tuberculosis mortality rates among women compared to men (Anderson 1990; Humphries 1991; Johansson 1996; McNay, Humphries, and Klasen 2005). However, more recent studies have questioned the nutritional component of this argument (Hinde 2015; Reid and Garrett 2018). Notably, this excess female mortality has been primarily a rural phenomenon in Europe (Alter, Manfredini, and Nystedt 2004; Tabutin and Willems 1998; Perner et al. 2022) and has often been linked to return migration (Cronjé 1984; Hinde 2015; Reid and Garrett 2018). Understanding the complex interplay between these factors is crucial in unravelling the patterns of tuberculosis mortality over the past centuries.

Despite tuberculosis's severity and significant mortality in historical populations, its demographic characteristics remain relatively underexplored, particularly outside of regions such as Great Britain, Northern Europe, and America.[1] The focus on Southern Europe is even more limited.[2] This descriptive study seeks to address this gap by providing new insights into tuberculosis mortality patterns in Mediterranean Europe using individual-level data from the mid-sized urban Greek population of Hermoupolis on the island of Syros. In particular, it examines the potential factors contributing to high tuberculosis mortality rates between 1916 and 1940, exploring variations by age, sex, and occupational class. It also assesses whether local public health interventions or changes in social and working conditions influenced these patterns over time. While this article represents the first demographic analysis of tuberculosis mortality in Greece, further research is essential to fully understand the true impact of tuberculosis in the country.

Tuberculosis had a profound impact on early twentieth-century Hermoupolis, where the disease remained a pressing public concern despite the implementation of an anti-tuberculosis campaign led by philanthropists and local physicians. The findings of the current study highlight the need for comprehensive measures to address the underlying factors contributing to tuberculosis, including sanitary reforms, improved living and working conditions, and nutrition. By understanding the historical context and unpacking the impact of tuberculosis, efforts could be directed towards preventing and combating the disease effectively in the present day in many developing populations.

The article begins by offering a brief overview of tuberculosis mortality differentials and declines, focusing on northwestern Europe and the United States, along with the prevailing debates in the literature. It then provides an in-depth overview of the anti-tuberculosis campaign and mortality in early twentieth-century Greece. This is followed by an introduction of the study population and a comprehensive exploration of the efforts undertaken by the Hermoupolis medical authorities to address the alarming rates of tuberculosis fatalities, drawing on qualitative evidence. Finally, the article outlines the data and methods employed in this research, culminating in the presentation and interpretation of the results in the final sections.

Evolution of tuberculosis mortality: A historical perspective

During the mid-nineteenth century, respiratory tuberculosis accounted for more than one-tenth of all recorded deaths in England and Wales (Woods and Shelton 1997). Its subsequent reduction explained over one-third of the overall decline in mortality between the 1860s and the 1890s (Wilson 1990; Woods 2000, 340). Tuberculosis posed a significant risk to individuals across all social classes; however, the poor working classes were particularly vulnerable due to several factors such as

[1]See, for instance, Table 1 in Davenport (2013, 2).

[2]In Italy, for instance, tuberculosis mortality has been primarily studied through all-cause mortality trends and at aggregate level, as cause-of-death information is unavailable before the 1920s or even later (Caselli 1996; Pinnelli and Mancini 1998; Del Panta and Pozzi 2011), or through the evolution of sanatoria treatment (see Martini et al. 2018).

inadequate diet, overcrowded housing, and unsanitary working conditions. This vulnerability was especially prominent in urban areas with poor ventilation and hygiene. During the period, there were no effective treatments or known methods to combat the virulence of the bacillus (Mercer 1990, 98).

McKeown (1976, 137–38; McKeown and Record 1962) suggested that improved nutrition was the main factor contributing to the decline of airborne diseases, primarily tuberculosis, which he argued accounted for half of the overall mortality decline in the nineteenth century, alongside reductions in pneumonia and bronchitis. On the other hand, Szreter (1988, 16–18) contended that social interventions, such as public health measures, housing reforms, and the development of sanitation infrastructure, were instrumental in lowering tuberculosis mortality rates as part of the broader decline in infectious diseases. More recently, Harris (2004) acknowledged the role of nutrition but also emphasized the importance of public health measures in reducing mortality rates, suggesting that nutrition should be viewed as one among several interlinked factors crucial to Britain's mortality transition.

By the early twentieth century, tuberculosis mortality in Britain had declined significantly and accounted for only one out of eight deaths (Bryder 1988). Similar patterns were observed in other European populations, including Scotland, Belgium, and the Netherlands (Murray 2015, 412). The decline in tuberculosis mortality has been traditionally attributed to improving living standards, better housing, hygiene and sanitary reforms, and improvements in environmental conditions (Cutler and Miller 2005; Cronjé 1984, 99; Hardy 1993, 211–13; McKeown 1976, 68; Puranen 1991, 105–15; Szreter 1988, 11–12; Vögele 1998, 5:145; Vynnycky and Fine 1999, 330–31; Woods 2000, 340).

Tuberculosis disproportionately affected several age groups, however, females experienced higher mortality rates than males during adolescence, early adulthood, and adulthood (ages 10–50) (Van Doren 2024; Davenport 2013). Even in the early twentieth century, tuberculosis was responsible for more than one-third of male deaths aged 15–44, half of female deaths aged 15–24, and one-quarter of female mortality in the age group 25–44 (Bryder 1988; Cronjé 1984, 83–84). In Sweden, tuberculosis was more prevalent among women in their early youth and during their reproductive period (Puranen 1991, 104–5). According to Noymer (2011), age-standardized death rates from tuberculosis for US females and males were between 12.5 and 20.0 deaths per 10,000 individuals, respectively, until 1918, after which there was a dramatic decline every year until they reached around 4.0 deaths per 10,000 by the end of the 1940s. Tuberculosis had declined during but also after the 1918 pandemic (Noymer 2011; 2009; Noymer and Garenne 2000), yet some places did not experience such declines or did not see an accelerated reduction in tuberculosis mortality decline (Tripp and Sawchuk 2017; Van Doren and Sattenspiel 2021). Recent evidence suggests that tuberculosis may have been an important risk factor for morbidity and mortality during the pandemic (Mamelund and Dimka 2019; Oei and Nishiura 2012; Zürcher et al. 2016), however, Noymer (2011) argued that overlooking the impact of the 1918 influenza pandemic in hastening the decline of tuberculosis mortality is a significant oversight that needs to be further addressed.

Respiratory tuberculosis created excess female mortality, especially in adolescence and young ages (Davenport 2013). One of the main reasons for higher female

tuberculosis mortality was poor nutrition, particularly in rural areas, which increased susceptibility to the disease (Hinde 2015, 367; McNay, Humphries, and Klasen 2005, 670). Additionally, Anderson (1990, 19) posited that the greater prevalence of tuberculosis in females was a result of the prevailing societal emphasis on ensuring that the male "breadwinner" remained well-nourished even in times of adversity. Another significant reason, particularly relevant to rural places, was the return migration of female out-migrants to their hometowns to receive care from their relatives (Cronjé 1984, 95; Hinde 2015, 371; Reid and Garrett 2018, 126). Although tuberculosis mortality declined across all age groups during the second half of the nineteenth-century mortality, it continued to be more prevalent among women (Hinde 2015, 370; Woods and Shelton 1997, 97). With the advent of effective antibiotic drug therapy in 1946, tuberculosis mortality significantly decreased for both sexes (Bryder 1988). Finally, in most populations, the age pattern of female tuberculosis mortality remained relatively stable even until the 1940s, while the age distribution for males shifted to older ages (Davenport 2013, 11).

The anti-tuberculosis campaign in Greece: philanthropic support and limited state intervention

Tuberculosis, initially suspected as an infectious disease in 1836, gained significant attention within the Greek medical community in the late nineteenth century following Robert Koch's discovery of the tubercle bacillus (Papakostas 1937, 338; Vlastos 2005, 12). Despite the state's inability to organize sufficient services to address high tuberculosis mortality and morbidity rates at the beginning of the twentieth century, private initiatives emerged to propose solutions. Besides, Greek physicians were also aware of the discussions and findings on hygiene and anti-tuberculosis campaigns taking place elsewhere in Europe (Stoyannides 2016, 148).

In 1901, the First Panhellenic Medical Congress acknowledged the high prevalence of phthisis in Greece and the lack of sanatorium-based treatment. This led to the foundation of *the Panhellenic Anti-Tuberculosis Association*, marking the beginning of the anti-tuberculosis campaign in Greece (Anon 1901; Theodorou 2002, 148). One of the association's primary goals was to promote the establishment of sanatoria throughout the country (Vlastos 2005, 20–21). In 1905, Athens saw the opening of the first national tuberculosis clinic, the *Soteria* sanatorium, with 52 hospital beds, funded by philanthropic efforts (Papastefanaki 2008b, 175; Stoyannides 2016, 208; Theodorou 2002, 160).[3] However, the lack of similar institutions across Greece meant that consumptives had to rely on general hospitals for treatment (Papakostas 1937, 338; Vlastos 2005, 37).

The first Conference Against Tuberculosis was held in Athens in 1909, highlighting tuberculosis as a national threat. Yet, no specific measures were implemented (Patrikios 1909; Theodorou 2002, 171). Philanthropic initiatives led to the establishment of another sanatorium in Pelion, a mountainous region in central Greece. In 1910, the Greek state began providing partial funding to the *Soteria* sanatorium and the *Panhellenic Anti-Tuberculosis Association*, marking a turning

[3]On the *Soteria* hospital, see Chatzikonstantinou and Sapounaki-Dracaki 2014; Kates 1984; Stavrakis 2002.

point in the campaign (Papakostas 1937, 338). By 1912, the second Conference Against Tuberculosis in Volos emphasized child protection from tuberculosis. In 1914, tuberculosis transmission was officially linked to unsanitary working conditions, prompting the enforcement of hygiene regulations in affected industries, such as typesetting shops (Stoyannides 2017, 32).[4]

From 1914 onwards, new sanatoria, including the *Parnitha* sanatorium near Athens, were established with funding from both the state and private charities. In 1920, the *Panhellenic Anti-Tuberculosis Association* founded the *Asklipion Voulas* in Athens, the first hospital specializing in surgical tuberculosis treatment for children (Papakostas 1937, 338). However, between 1912 and 1922, a tumultuous period in Modern Greek history, the state's involvement in the anti-tuberculosis campaign was limited, with financial contributions mainly from charities and the medical community (Stoyannides 2016, 195).

In the early 1920s, the Greeks attempted to re-establish the national anti-tuberculosis campaign by reorganizing the public health system. To achieve this, a law was passed mandating the creation of anti-tuberculosis dispensaries, tuberculosis hospitals, and sanatoria, funded by the state in collaboration with local councils, municipalities, the Church, and port authorities (Theodorou and Karakatsani 2008, 56).[5] This effort included sending doctors to Switzerland for training to ensure the effective operation of these institutions.[6] However, these plans were disrupted by the influx of Asia Minor refugees in 1922–23 (Kyriazides 1929, 59; Stoyannides 2017, 204). After the Greek military campaign in Asia Minor failed and the Treaty of Lausanne was signed, about 1.3 million Christian refugees of Greek origin fled to Greece, many in dire conditions. The refugees settled in provincial areas without basic hygiene facilities, leading to the rapid spread of tuberculosis, among other infectious diseases (Kontogiorgi 2006, 266–77; Liakos 1993, 54–60).

Between 1924 and 1927, the Greek state took little action to combat tuberculosis, beyond funding the *Sotiria* Sanatorium. Private charities continued to establish sanatoria in various regions. In 1925, the *Hellenic Anti-Tuberculosis Association* (*Ellenike Antifthisike Etaireia*) was founded to reorganize the anti-tuberculosis movement. It set up dispensaries in Athens, Piraeus, and other areas but lacked the financial resources to sustain these efforts. The association focused on raising public awareness through lectures and publications on tuberculosis transmission (Pampoukes 1927; Papakostas 1937, 338–39; Stoyannides 2016, 104).

In 1929, the state attempted to reform the public health system by placing a special emphasis on the high levels of tuberculosis. Hygiene centres with anti-tuberculosis clinics and a Centre for Tuberculosis Treatment (*Fymatiologiko Kentro*) within the *Soteria* sanatorium were established, but these initiatives lasted only two years. By 1932, the state continued its anti-tuberculosis efforts with limited

[4]V.D. Peri Kanonismou Ygieines Ton Typographeion [Royal Decree Concerning the Hygiene Regulations of Printing Works] (1914).

[5]'Peri Tes Idryseos Antifymatikon Iatreion, Nosokomeion, Anarroterion Kai Oreinon Therapephterion' [Concerning the Foundation of Dispensaries, Tuberculosis Hospitals, Sanatoria and Preventoria] (1920).

[6]2358/1979/1920/ Peri Tes Idryseos Antifymatikon Iatreion, Nosokomeion, Anarroterion Kai Oreinon Therapephterion [Concerning the Foundation of Dispensaries, Tuberculosis Hospitals, Sanatoria, and Preventoria] (1920).

laws, including Law 6008, which aimed to enhance regional health care by expanding hospital capacities.[7]

During Metaxas's dictatorship (1936–1940), it was claimed that the infrastructure of the anti-tuberculosis campaign was further strengthened. Existing sanatoria were expanded in areas such as Chania, Mytilene, Kavala, and Thessaloniki, although plans for further developments were halted by World War II (Papakostas 1937, 339; Zaharias 2007, 98). Metaxas's plan to address the high tuberculosis mortality and morbidity was considered by Stoyannides (2016, 218) to be more ambitious and far-reaching than those of previous governments.[8]

In summary, the persistence of tuberculosis in Greece during the early twentieth century was driven by limited funding, inadequate medical care, and poor living and working conditions among the lower social classes (Papastefanaki 2011, 170).

Tuberculosis mortality in Greece in the early twentieth century: Trends and patterns

The scarcity of national statistics concerning cause-specific mortality in Greece before 1921 is the primary reason for the lack of accurate mortality rates. From the early twentieth century, contemporary physicians and hygienists attempted to estimate tuberculosis mortality levels in Greece but achieved limited success (Theodorou 2002). Therefore, the genuine levels of tuberculosis mortality remain an unsolved puzzle.

One of the earliest studies estimated that more than 10,000 tuberculosis deaths occurred annually in early-twentieth-century Greece and suggested that each tuberculosis death corresponded to three consumptives (Savvas 1915, 15). Patrikios (1901, 64, 68, 73) argued that tuberculosis mortality in Greece was among the highest in Europe. Kardamates (1917, 94) estimated that national tuberculosis mortality levels between 1899 and 1908 were 18 per 10,000 population by dividing Greece into urban and rural areas based on population size. Foustanos (1917, 121–26) estimated that tuberculosis mortality in Greece in 1906 ranged from 10 to 36 per 10,000 depending on settlement size, with a national average of 25 per 10,000. However, comparing his results with those of France, he questioned the severity of tuberculosis in Greece, suggesting the annual number of tuberculosis deaths was fewer than 4,000, contrary to previous estimates of 9,000. Both Kardamates and Foustanos found that the largest urban centers suffered significantly higher tuberculosis than rural areas. However, attempts to verify their rates revealed discrepancies. Their estimates appeared to be simple averages of figures calculated for each settlement category, disregarding the varying population sizes. For instance, Foustanos's estimated rate of 25 per 10,000 dropped to approximately 15 when

[7]1934/6008 Peri Organoseos Peripheriakes Ygeionomikes Yperesias Toy Ypourgeiou Kratikes Ygieines Kai Antilipseos' [Concerning the Organizing of the Regional Hygiene Service of the Ministry of Public Hygiene and Awareness].

[8]McDougall's comprehensive account of tuberculosis in Greece in the mid-1940s shed light on the difficulties and inability of the state to address the high incidence of tuberculosis. Pages 115–116 of his work featured photographs that starkly depicted the deplorable conditions that existed in Greek sanatoria as far back as 1937–38. These images served as a testament to the alarming neglect and mismanagement that plagued these facilities (McDougall 1948).

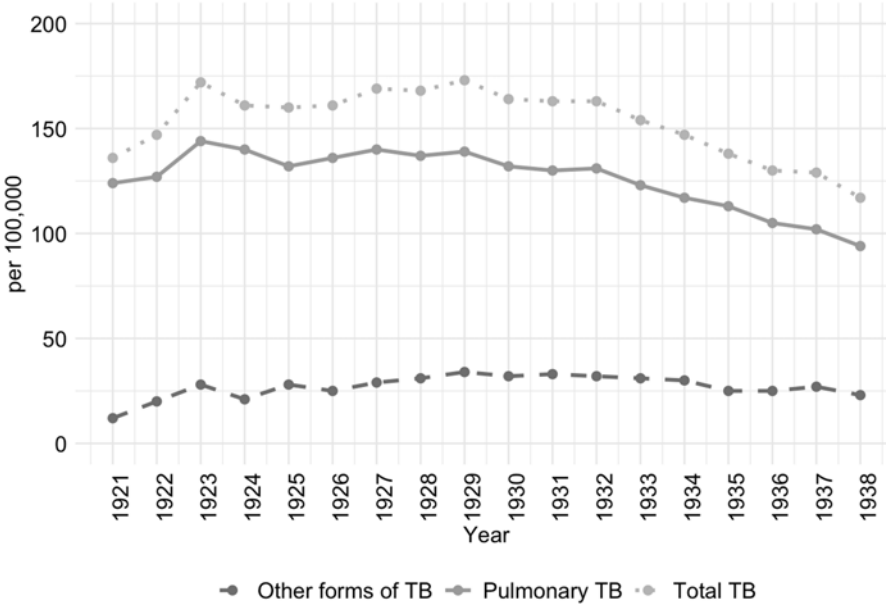

Figure 1. Tuberculosis-specific mortality rates per 100,000 population, Greece, 1921–1938.
Note: Calculated by the author using the number of deaths attributed to tuberculosis and the population at risk as recorded in the annual publication of the vital statistics.
Source: NSSG 1921b; 1921a

recalculated using the total number of tuberculosis deaths and the total population of Greece. Similarly, Kardamates's estimated rate of 18 per 10,000 was recalculated to 11.

Among the available studies, Rondopoulos's work appears to be the most detailed. He reported 38,534 tuberculosis deaths (22,008 males and 16,525 females) between 1890 and 1914. Rondopoulos (1917, 100–102, 138–41) estimated that tuberculosis mortality in the 14 largest cities in Greece was 40.8 per 10,000 during this period, a figure notably high compared to other European countries. He also observed that variations in tuberculosis mortality corresponded to changes in urban population sizes, except in Hermoupolis. Despite a population decline in Hermoupolis (from 22,104 in 1889 to 18,132 in 1907), tuberculosis mortality there increased.

According to a 1918 report by the Panhellenic Anti-Tuberculosis Association, tuberculosis mortality rose significantly during and after the Balkan Wars and World War I. This increase was attributed to worsening living conditions caused by national financial instability and military mobilization. Due to time constraints, physicians could not thoroughly examine all recruits, leading many consumptives to join the army. Additionally, healthy soldiers likely contracted tuberculosis under harsh combat conditions, and upon returning home, these consumptives infected their families (Anagnostopoulos 1928, 28; Anon 1919; Stoyannides 2016, 102).

In 1921, the first national cause-of-death statistics were published, listing the number of deaths attributed to each cause (NSSG 1921b). Figure 1 shows national

tuberculosis mortality rates per 100,000 inhabitants for the period 1921–1938. During this time, pulmonary tuberculosis was consistently the deadliest form. A significant increase in tuberculosis mortality occurred in 1923, likely due to the arrival of Asia Minor refugees. Tuberculosis mortality remained high, exceeding 160 per 100,000 until 1932. However, a decline began in 1933, albeit at a slower pace in urban centers due to the "urban penalty" prevalent in Greece, as noted by Papakostas (1937, 334).

Study population: Hermoupolis, Syros

During the mid-nineteenth century, Hermoupolis was a significant Greek urban center, serving as the capital of the Cycladic Island of Syros, a major industrial hub, and one of the largest ports in the Eastern Mediterranean. However, by the late nineteenth century, the city experienced an economic decline due to the rise of other ports and industrial centers on the Greek mainland. Consequently, Hermoupolis transformed into a less populated city, with fewer than 20,000 inhabitants. Nevertheless, the city's textile manufacturing industry flourished in the early twentieth century, reducing the previous decades' recession (Kolodny 1969; Travlos and Kokkou 1980; Loukos 2022).

Despite the advances in medical services in Hermoupolis, including the establishment of a hospital as early as 1827 and a strong association of physicians from the mid-nineteenth century, hygienic conditions in the city remained relatively poor, as was typical for most urban areas in Greece at the time.[9] The lack of a water supply system, inefficient sewage disposal, high population density, and poor housing conditions, along with the low living standards among the working classes, led to the almost annual occurrence of epidemics, despite local authorities' efforts to improve public hygiene. As a result, Hermoupolis residents faced an "urban penalty" from the mid-nineteenth to the early twentieth century, with higher exposure to diseases compared to rural populations. Mortality levels in Hermoupolis exceeded the national Greek average, with a high prevalence of infectious diseases, especially tuberculosis among young adults, and diarrheal diseases among infants and young children. In 1907, life expectancy at birth was alarmingly low: 34.7 years for males and 36.2 years for females. Although life expectancy improved by 1920 due to a decline in infant mortality, it remained below the national average. By 1928, it had reached almost 46 years of age for females and 43 years for males. In the 1930s, the penalty was eliminated, likely due to changes in the registration system, mass immunizations, improved living standards and nutrition among lower strata infants, increased maternal literacy, mortality-fertility

[9]The medical system in Greece was found to be insufficient even until the 1930s, while medicine was largely ineffective before the 1940s, limiting its contribution to mortality decline. However, local physicians played a significant role by publishing public hygiene advice and collaborating with authorities to improve medical care and sanitation. For a more comprehensive analysis of public health in Hermoupolis, see Raftakis (2019, 2022c).

While Hermoupolis offered medical services that might have attracted outsiders, most inhabitants of nearby islands preferred traveling to Athens for its wider and superior healthcare options. Rural residents of Syros and Ano Syros rarely used the local hospital in Hermoupolis, opting instead for the French Catholic hospital, which primarily served the Catholics (Hionidou 2009).

interaction during the demographic transition, and wider access to water. The introduction of an underground water supply system in the mid-1920s, though not covering the entire city, may have contributed to improved personal hygiene among residents (Raftakis 2022b; 2019; 2021).

Hermoupolis's approach to combating tuberculosis mortality

Fragkides (1894, 56) argued that tuberculosis was the leading cause of death in Hermoupolis, estimating that it was responsible for an average of 103 out of 635 annual deaths in the late-nineteenth century. Foustanos (1917, 124–25), a prominent physician and publisher of perhaps the most well-known Greek medical journal *Iatrike Proodos*, criticized the validity of Fragkides's estimates. He contended that the figures were artificially inflated because he combined data from two different population groups: the number of tuberculosis deaths on the entire island of Syros and the population of Hermoupolis (18,132), instead of the island's population (22,238).

Arfanes's estimates indicate that Hermoupolis had a tuberculosis mortality rate of 54 per 10,000 during the period 1899–1908, significantly higher than in any other Greek city at the time. Corfu followed with 40 per 10,000, then Patras (38), Athens (37), and Piraeus (31). Arfanes (1918, 2–3) further estimated that 1,102 tuberculosis deaths occurred in Hermoupolis during this period, averaging 122 deaths annually. Between 1909 and 1917, tuberculosis mortality remained high, fluctuating between 40 and 56 per 10,000 and accounting for approximately one-fifth of all deaths in the city (Figure 2).

Arfanes (1918, 4–5)[10] wrote a public letter to the Prefect of the Cyclades, expressing concerns over the persistently high tuberculosis mortality in Hermoupolis. This occurred despite the city having a municipal disinfection service, two hospitals, a hospital for infectious diseases and another for smallpox treatment, and various philanthropic institutions.[11] Other medical reports in the early 1920s also attributed tuberculosis in Hermoupolis to poor public hygiene (Goulandres 1921, 10). No initiatives to address tuberculosis appear to have been undertaken before 1915, as evidenced by a letter from the Medical Association of Syros to the Prefect of the Cyclades requesting the establishment of a dispensary in Hermoupolis. However, no action was taken to fulfill this request (Newspaper *To Vema*, Δ/216 19 February 1915:1–2).

Arfanes (1918, 8–9) proposed to the Hygiene Association of Syros, a few years later, the creation of a sanatorium for isolating and hospitalizing patients in the final stage of tuberculosis. This institution would replace the *Kaiadas*,[12] a room for impoverished consumptives at the local hospital that operated until 1916. The room bore Dante's grim inscription *"Lasciate ogni speranza voi ch'entrate"* ("Abandon all

[10]Arfanes was a local physician, who repeatedly brought public-health-related concerns to the attention of the municipal authorities, highlighting issues such as the quality of water from the island's natural springs and the well-being of foundling infants.

[11]Not all institutions were operational throughout the entire study period, nor were they operational simultaneously.

[12]According to the myth, *Kaiadas* was the gorge where the Spartans would discard their weak and deformed infants, as well as their enemies, war prisoners, and criminals.

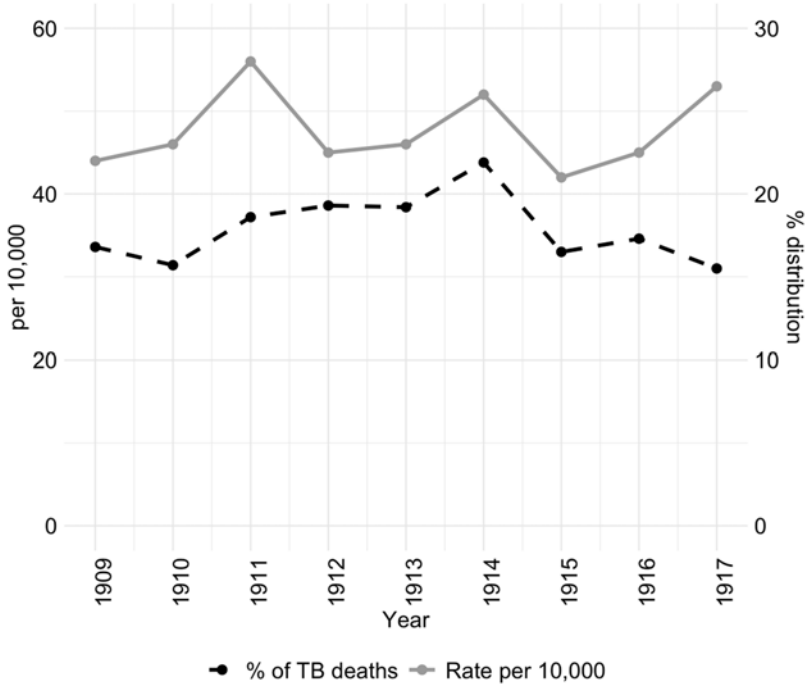

Figure 2. Tuberculosis mortality rates and percentage distribution of tuberculosis deaths in Hermoupolis, 1909–1917.
Note: The data used by Arfanes to estimate tuberculosis mortality are not explicitly stated in the source material and therefore remain unclear (see also main text).
Source: Arfanes 1918: 2

hope, ye who enter here").[13] Following its closure in 1916, consumptives across the island were left without access to medical care, forcing the poorest to beg in the city streets and cafés. Arfanes emphasized the urgent need for a sanatorium, not only for treating patients but also for safeguarding public health and preventing the disease's spread.

The Hygiene Association of Syros was founded in 1918 by the Medical Association of Syros and local philanthropists and aimed to combat tuberculosis. As state measures against the disease were ineffective outside Athens until the 1930s, the Association's efforts were vital for Hermoupolis. Arfanes (1918, 9) outlined the Association's objectives, including establishing preventoria, sanatoria with medical and x-ray laboratories, and a dispensary to educate the public on preventive measures. That year, the Association encouraged local authorities to establish a temporary sanatorium in Hermoupolis. While the municipal council granted the use of the smallpox hospital for this purpose, there is no evidence the plan was implemented.[14]

[13]Dante, *The Divine Comedy*, Inferno, Canto 3, line 9.

[14]General State Archives of Syros (hereafter GSAS)/Demotiko Archeio [Municipal Archive] (hereafter DA)/Praktika Demotikou Symvouliou [Minutes of the Municipal Council] (PDS hereafter): 504/171 15 March 1919; 505/172 21 March 1919.

In May 1919, Hermoupolis saw the opening of its first dispensary for consumptives, providing medicine, milk, and meat to working-class patients (Travlos and Kokkou 1980, 32). That same year, the *Avrofilito* sanatorium opened, thanks to a mansion donated by Leonidas Empeirikos, a shipowner, cofounder of the National Steamboat Company, parliamentarian, and former Minister of Food. The sanatorium was located in Episkopeio, 5 kilometers from Hermoupolis, in what contemporaries considered an excellent location. Given that the existing building could not meet the needs of the entire island, Emperikos financed the construction of a new facility, *To Neon Empeirikeion Peripteron*, adjacent to the original structure. The sanatorium housed 25–30 hospital beds and was equipped with an incinerator, an autoclave for waste combustion and the disinfection of consumptives' personal belongings, such as clothing and bedding. (Gerasimides 1933, 67; Goulandres 1921, 12–16).

For the first few years, the sanatorium and the dispensary operated solely on charitable donations without state financial support. By the 1930s, however, the Association received joint funding from the Ministry of Hygiene and the Municipality of Hermoupolis. Despite this, financial constraints hindered the effective operation of its facilities.[15] In 1929, the Cyclades' medical officer publicly criticized the Hermoupolis dispensary, pointing out irregular examinations, lack of tests and x-rays, and inadequate funding. He urged the state to reorganize and support the dispensary, but no significant changes occurred.[16] In 1934, the head of the Hygiene Association appealed to Hermoupolis's wealthy residents for donations to sustain the sanatorium (Newspaper *Kykladika Nea*, EA/2/19 21 November 1934: 1).

Medical reports consistently highlighted limited action against tuberculosis in Hermoupolis. In 1939, the Cyclades' medical officer proposed establishing a regional sanatorium funded by the state and philanthropists. However, this plan was abandoned due to the outbreak of World War II, with funds redirected toward building a new hospital in 1956.[17]

Throughout the early twentieth century, it seems that local authorities implemented only one measure against tuberculosis, which was to disinfect the households of consumptives. In fact, Hermoupolis became home to the first municipal disinfection service in Greece, established in 1903 (Newspaper *To Vema*, Δ/216 19 February 1915: 1–2). However, Tsakalotos (1914, 22–23) criticized the service as understaffed and poorly equipped, with its sterilizer in disrepair.

Data and methods

Tuberculosis-specific mortality rates were calculated around the years 1920, 1928, 1934, and 1940 using individual-level civil death registers and census data. While

[15]GSAS/ Ygeia kai Pronoia Archeio [Health and Welfare Archive] (hereafter YPA)/YP1310/Etesia ekthese ygieinomikes katastaseos Kykladon (Annual report on public hygiene in Cyclades] (hereafter Etesia), 1930-1937/1936; GSAS/ DA/PDS: 804/67 1 February 1937.

[16]GSAS/YPA/YP965/1929, Epistole tou Nomiatrou Kykladon pros to Ypourgeio Ygieines, Pronoias kai Antilepseos, [Public letter from the medical officer of the Prefecture of the Cyclades to the Minister of Health, Welfare and Care].

[17]GSAS/YPA/YP1310/ Etesia, 1930–1937/1936.

death registration in Hermoupolis has been available continuously since 1859, causes of death were recorded only from 1916 onwards, along with the name of the doctor who confirmed the death and its specified cause. All death records were transcribed into the *Hermoupolis Mortality DATABASE*.[18] To classify the causes of death, a linked version of ICD-3 and the Intermediate ICD-4 was used, combining the former's causes of death descriptions with the coding from the latter.[19]

Although evidence from other Greek populations indicates that causes other than tuberculosis were sometimes reported on death certificates, potentially leading to the underreporting of the disease, this does not seem to be a significant issue in Hermoupolis. For example, Sideres (1983, 114–15) reported that in the 1820s on Lefkada, terms like pleurisy (*pleyritida*) and scrofula (*choiradose*) were used to describe tuberculosis. Similarly, Rondopoulos (1909, 509) suggested that some families would list chronic bronchial catarrh (*chronios vrochikos katarrous*) as the cause of death instead of tuberculosis (Moustane 2014, 255). However, such specific causes were rarely recorded in the Hermoupolis data, suggesting minimal misreporting of tuberculosis. This may be due to the high incidence of the disease in the city at the beginning of the twentieth century. Furthermore, oral evidence[20] indicates that tuberculosis was difficult to conceal because its symptoms, particularly in advanced stages, were visibly apparent.

Age-specific and sex-specific tuberculosis mortality rates were calculated around two years: 1920 (1916–1924) and 1928 (1926–1932). These calculations used the average number of tuberculosis deaths and the populations at risk as reported in the 1920 and 1928 censuses (NSSG 1923; 1935). No census was conducted during the 1930s while the 1940 census material was never analyzed due to Greece's involvement in World War II. Therefore, no similar calculations were performed for 1934 and 1940. Instead, the proportion of tuberculosis deaths relative to the total number of deaths was calculated by sex and age, using the average number of deaths. However, due to the small number of deaths in each sex and age group (fewer than 10 per age group and sex per year), the discussion of these rates is limited.

To provide a national comparison, similar tuberculosis mortality rates were estimated for Greece as a whole for the period 1921–1938, during which annual statistics of causes of death were available (NSSG 1921b). It should be noted, however, that under-registration of vital events was common, particularly in the rural areas of Greece, during the early years of this period. The 1956 census indicated that many communities failed to provide relevant data on vital events between 1920 and 1927, likely resulting in an underestimation of national

[18]All individual-level death records are available on-site in the General State Archives of Syros and the Syros Registry Office: ('Leksiarchika Vivlia Apovioseon [Civil Death Registration manuscript books] 1859–1924'; 'Leksiarchika Vivlia Apovioseon [Civil Death Registration manuscript books] 1925–1940'). For a descriptive analysis of the database, along with some recent works that had employed it, see Raftakis (2019, 39–43; 2021, 411–12; 2022b; 2022c).

[19]The Greek vital registration used two different versions of the International Classification of Diseases (ICD) during the period under study. From 1922 until 1931, ICD-3 was used, while from 1931 onwards, ICD-4 was used. (See also Hionidou 2006, 204; Raftakis 2019, 174).

[20]The Syros interviews were conducted by Prof. Violetta Hionidou for her research project on the Greek famine of 1941–42 (Hionidou 2006, 29–30; 2020; 2016). For full extracts related to Hermoupolis' public health, see Raftakis (2019).

tuberculosis mortality levels (NSSG 1956, XV). By 1928, however, vital registration appears to have been fully complete (NSSG, 1956, p. XV).[21]

Death records also provide information on the occupation of both deceased adults and the parents of deceased children, enabling an analysis of socioeconomic inequalities in tuberculosis mortality during the study period. However, historical data often lack information on women's occupations. In Greece, most women left paid employment upon marriage, upon marriage. For non-employed women aged 15 and older, the occupational group of their husband (if married) or their father (if unmarried) was utilized. Occupations (mainly available for the male population) were stratified into occupational groups based on the Historical International Standard Classification of Occupations (HISCO) and then converted into classes using the Historical International Social Class Scheme (HISCLASS) (Van Leeuwen, and Maas 2011; Van Leeuwen, Maas, and Miles 2002).[22] Nevertheless, applying such classifications to Greek data are debatable. Even in the early twentieth century, the roles of producer, seller, and consumer often overlapped within the same individual at smaller geographical units. Since this marks an initial attempt to adopt an international occupational classification system using Greek data, caution should be exercised when interpreting these results.

Understanding tuberculosis mortality patterns in Hermoupolis: Results

Between 1916 and 1940, tuberculosis caused over 1,500 deaths in Hermoupolis, comprising 15 percent of total mortality. Individuals aged 15 and 34 were most affected, with more than one-third of tuberculosis deaths in both sexes occurring within these groups, a pattern in line with findings from other populations (Davenport 2013; Van Doren 2024; Reid and Garrett 2018; Cronjé 1984). Among those aged 15–24, the impact was particularly severe, as tuberculosis accounted for nearly half of all deaths in this age bracket. Overall, it was the deadliest of all infectious diseases, responsible for almost half of all deaths from such causes. Pulmonary tuberculosis made up more than half of all tuberculosis deaths and declined more rapidly than other forms, significantly contributing to the overall decrease in tuberculosis mortality during the 1920s (Figure 3).

The remarkably high levels of tuberculosis in Hermoupolis substantiate the claim by contemporary physicians that the city had the highest rates in Greece (Arfanes 1918; Foustanos 1917; Fragkides 1894; Rondopoulos 1917). In 1920, tuberculosis mortality was 500 deaths per 100,000 inhabitants, calculated using the average deaths from 1916 to 1924, a period including the lethal influenza pandemic in 1918–19 (Figures 3 and 4). The pandemic may have influenced tuberculosis mortality through a "harvesting effect," wherein individuals who might have died from tuberculosis succumbed to influenza instead. Despite this, tuberculosis rates

[21]For further discussion about under-registration of vital events in Greece during the 1920s and 1930s, see also Raftakis (2023).

[22]To classify occupations into occupational groups or to understand the meaning and responsibilities of certain occupations that no longer exist, the following sources were consulted: Violetta Hionidou, who had previously assigned HISCO codes to several Greek occupational titles based on Mykonos marriage acts (1859–1959): https://historyofwork.iisg.nl/index.php, accessed 10 March 2024; Anagnostake 2007; Bafounis 1984; Yannitsiotis n.d.

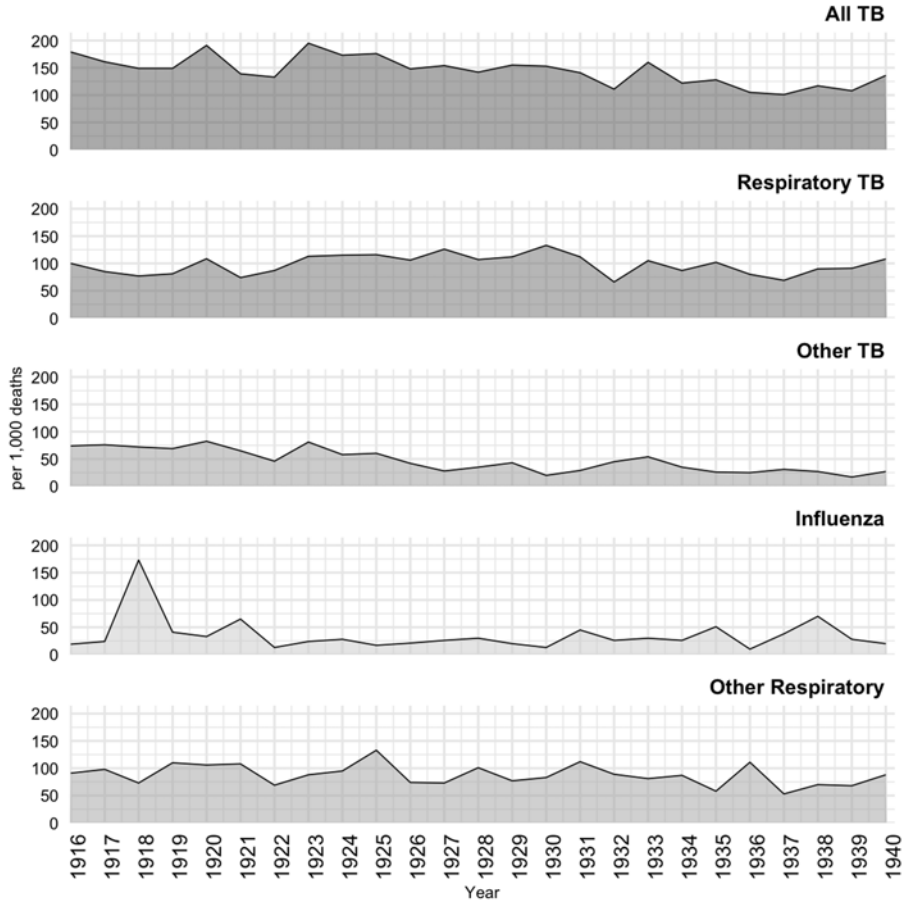

Figure 3. Annual distribution of deaths due to tuberculosis (all forms), influenza, and respiratory diseases per 1,000 deaths, Hermoupolis, 1916–1940.
Source: Hermoupolis Mortality DATABASE.

declined only marginally, and tuberculosis may have been a risk factor for pandemic infection due to overlapping age-specific patterns (Raftakis 2019; 2022a). Although the 1918 influenza pandemic has been associated with post-pandemic declines in tuberculosis mortality (Noymer 2009; 2011; Noymer and Garenne 2000), Hermoupolis did not experience such a reduction (as shown in Figure 1), aligning with findings from other locations around the world (Tripp and Sawchuk 2017; Van Doren and Sattenspiel 2021). Tuberculosis mortality actually increased in subsequent years, likely due to deteriorating living conditions and poor hygiene following the arrival of Asia Minor refugees, conditions that contributed to a general rise in infectious disease mortality (Raftakis 2019; 2022b). By 1928, tuberculosis mortality had almost halved, dropping to 283 per 100,000 (average mortality between 1925 and 1931). Throughout the 1930s, the overall tuberculosis mortality continued to decline, reaching 208 per 100,000 in 1934 and 192 in 1940, though the decline plateaued in the latter half of the decade.

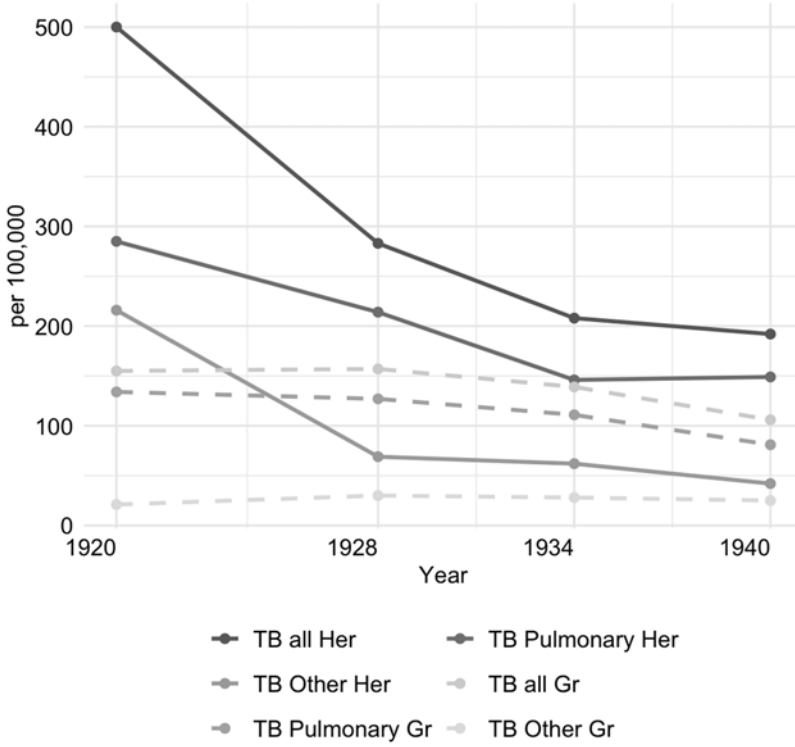

Figure 4. Tuberculosis-specific mortality, Hermoupolis and Greece, 1920–1940 (rates per 100,000 inhabitants).

Note: The rates for Greece have been calculated for 1922, 1928, 1934, and 1938 using the average number of deaths attributed to tuberculosis around those years and the total population of the country (see also main text). Gr refers to Greece as a whole, based on published statistics, while Her refers to Hermoupolis based on individual-level death records.

Sources: Hermoupolis Mortality DATABASE; Statistike ton aition thanaton (1921–1938).

The decline in tuberculosis mortality before the advent of effective drug treatments or vaccines remains incompletely understood. Potential explanations include increased genetic resistance (Lipsitch and Sousa 2002), improved nutrition and poverty reduction (McKeown and Record 1962; McKeown 1976; Harris 2004), reduced transmission through better isolation and decreased overcrowding (Wilson 1990; Vynnycky and Fine 1999), and improvements in housing and sanitation improvements (Cronjé 1984; Harris 2004; Pooley and Pooley 1984; Szreter 1988; Vögele 1998; Woods and Shelton 1997; Woods 2000). A decline in pathogen virulence has also been proposed (Woods 2000).

In Hermoupolis, there is no evidence that improved nutrition occurred during the early twentieth century; undernourishment, as a result of the economic shrinkage, may have actually contributed to high tuberculosis mortality. Babanases (1981) identified widespread undernourishment in Greece during the interwar period, and contemporary physicians linked high tuberculosis prevalence to malnutrition in the 1930s (Theodorou 2009, 258). Soup kitchens operated in Hermoupolis during the 1920s and 1930s to address low living standards and high

unemployment among the working classes (Newspaper *Tharros*, B/43 17 January 1925: 1; B/70 22 April 1925: 1; E/313 26 January 1929: 1; H/549 23 June 1933, 549: 1). While Fragkiades (2007) and Petmezas (2007) suggested increased agricultural productivity in the 1930s, potentially leading to improvements in the country's nutritional sufficiency, there is little evidence of improved nutritional status in either the city or the country as whole before the 1950s (Babanases 1981; Gutenschwager 1989; Raftakis 2022b).

Evidence from early twentieth-century Glasgow and even 1980s Liverpool found a strong correlation between tuberculosis mortality and factors such as poor housing, low incomes, and high unemployment (Mcfarlane 1989, 84; Spence et al. 1993, 760). Similarly, contemporary public health reports attributed tuberculosis spread in Hermoupolis to poor housing conditions. Most working-class houses in Hermoupolis were characterized by dampness and insufficient sunlight.[23] Additionally, the establishment of the sanatorium and dispensary in 1919 may have contributed to the reduction of tuberculosis mortality, by simply isolating tuberculosis patients. Although this should not be entirely disregarded, it is important to note that, as widely discussed in the literature, sanatorium treatment was largely ineffective until the late 1940s, before the advent of antibiotics (Zwick and Pepperell 2020; Murray, Schraufnagel, and Hopewell 2015).

Industrial activity in Hermoupolis may have also contributed to the high incidence of tuberculosis. In the mid-1910s, state labor inspectors found that most of the factories in Greece were unhealthy and dangerous (Papastefanaki 2005, 164), and similar conditions were identified in Hermoupolis by Tsakalotos (1914, 26–27) at the same time as well. Extremely poor working conditions existed in every factory in the city he visited, with a complete lack of medical care, air extractors, and toilets, while food that was provided to the workers was found to be insufficient. Although Hermoupolis' main industrial activity had declined during the first half of the twentieth century, the rapidly developing textile manufacturing industry revitalized the island's economy, maintaining its significance until 1929, after which it slowed considerably (Papastefanaki 2008b, 159–60). Therefore, the decline in tuberculosis in the late 1920s and 1930s may have been influenced by the reduction in industrial activity in the city. Furthermore, Greek legislation introduced hygiene regulations in specific industries in 1914, which gradually improved working conditions in sectors nationwide over the following decades. The Greek governments also enacted new laws to protect workers by providing benefits or medical care to consumptive workers. While there is no evidence to make such links for Hermoupolis, improved treatment of industrial laborers– both by the state and by employers in terms of working conditions– may have also contributed to the decline in tuberculosis mortality from the late 1920s onwards.[24]

Tuberculosis mortality in Hermoupolis was consistently higher than the national rate, during the 1920s and 1930s (Figure 4). For Greece as a whole, tuberculosis

[23]GSAS/YPA/YP917/Etesia, 1931

[24]Several scholars have explored the relationship between tuberculosis infection and legislation aimed at protecting consumptive workers during the interwar period. Stoyannides (2016, 221–54; 2017) provides an in-depth analysis of this link, while Papastefanaki (2008a, 271–74; 2011, 174–81) also examines this topic in her works.

mortality is likely underestimated for the period between 1920 and 1927, due to incomplete data from several rural communities in certain parts of the country. Despite this limitation, Figure 4 shows that in the early 1920s, tuberculosis mortality in Hermoupolis was nearly twice as high as the national rate. By 1928, tuberculosis-specific mortality had declined notably in Hermoupolis while remaining relatively stable at the national level. At this point, the quality of vital statistics had improved and should be considered complete, leading to more accurate estimates from 1928 onwards. However, this improvement in data coverage may obscure any actual decline in the national tuberculosis mortality rate during this period. As tuberculosis mortality continued to decline in the 1930s, the gap between the two rates further narrowed. Throughout the study period, pulmonary tuberculosis remained the deadliest form of the disease, both in Hermoupolis and across Greece.

Urban-rural differences in tuberculosis mortality in Greece are further supported by evidence from other urban areas. For example, a study of Patras, a major urban center, also revealed a high incidence of tuberculosis in the early twentieth century. While the rate remained stable for much of the first half of the twentieth century – 24.65 per 10,000 inhabitants in 1907 – it declined to 17.7 in 1928 and further to 12.7 in 1940. Exceptions of this decline occurred during periods of increased incidence, such as World War I and the Asia Minor refugee influx in 1923 (Eliopoulos 2010, 267). Compared to Patras, Hermoupolis exhibited much higher tuberculosis levels, especially in 1940, when the rate was 19.2. Similarly, high tuberculosis levels were reported in Volos at the beginning of the century, where 10 percent of all deaths were attributed to the disease (Moustane 2014, 254, 256).

Further evidence of the urban-rural differences emerges from comparisons with other urban, semi-urban, or rural populations during the period 1937 to 1940. Hionidou's calculations show that tuberculosis mortality in Hios town was 104 per 100,000; in Vrontados (also on Hios Island) was 80, and on semi-urban Mykonos was 73. In contrast, tuberculosis mortality in rural Syros was extremely low at 54 per 100,000, while rates in neighboring Ano Syros[25] were comparable to those of Hermoupolis (Hionidou 2006, 206). This suggests that the high incidence of tuberculosis on the island of Syros was primarily an urban phenomenon. One possible reason for these stark urban-rural differences on a single island, beyond overcrowding, poor housing, and unhealthy working conditions in urban Hermoupolis, could be the better availability of food in the rural parts of the islands. Access to land also played a significant role in reducing mortality during the 1941–43 famine, with rural parts of the island experiencing much lower mortality rates compared to Hermoupolis or Ano Syros (Hionidou 2006, 164–65).

When examining tuberculosis mortality by age group, it becomes apparent that in 1920, rates were relatively high across all age groups (Figure 5). Nonetheless, slightly higher levels were observed in the 0–4 age group and throughout adulthood, starting from age 20. Atkins (1992, 218) has previously linked infant tuberculosis mortality to contaminated milk supplies. Nevertheless, the milk supply in Hermoupolis was found to be clean and, therefore, unlikely to have contributed

[25]Despite the close proximity between Ano Syros and Hermoupolis, the calculation of separate rates is straightforward due to the distinct religious affiliations (Catholics vs Orthodox Christians) in each settlement, which led to the maintenance of separate registration systems.

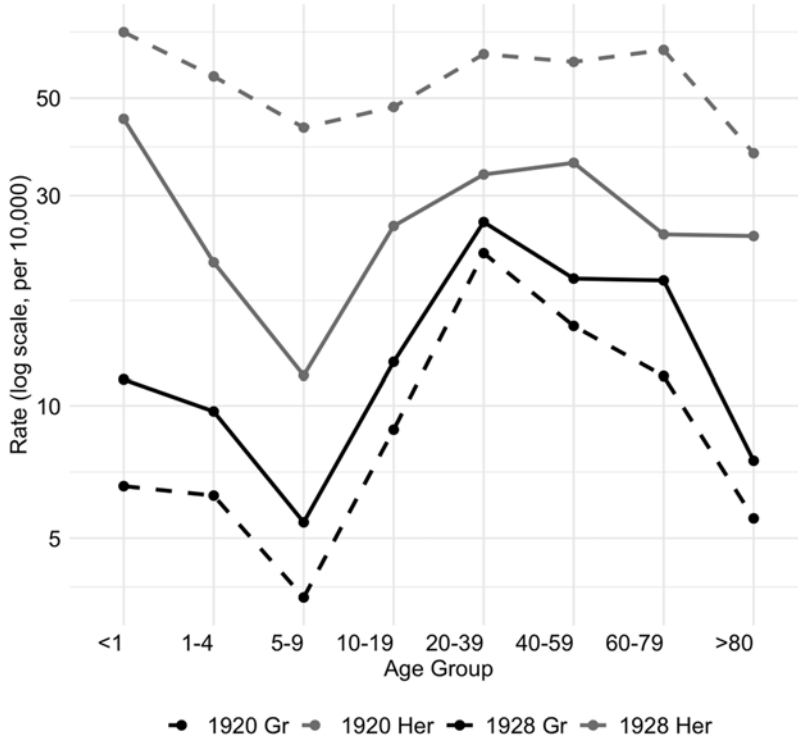

Figure 5. Age-specific mortality due to TB (all forms) in Hermoupolis and Greece, 1920 and 1928.
Note: Gr refers to Greece as a whole, based on published statistics, while Her refers to Hermoupolis based on individual-level death records.
Sources: Hermoupolis Mortality DATABASE; Greek censuses; Causes of death statistics (1921–1938).

to tuberculosis incidence among infants (Raftakis 2019).[26] Instead, infants were likely infected by whoever breastfeeding them, whether their own mother or another woman (e.g., wetnurses). Exposure to infectious breastfeeding mothers was probably a primary source of infection, while infants' vulnerability to tuberculosis mortality was further exacerbated by their immature and underdeveloped immune systems.

By 1928, tuberculosis mortality had declined across all age groups, though higher levels persisted in infancy and from early adulthood through the late 50s. When comparing age-specific tuberculosis mortality in Hermoupolis to that of Greece as a whole, it becomes evident that rates in Hermoupolis were consistently higher throughout the 1920s across the life course. However, the age-specific patterns in Greece were remarkably similar, with tuberculosis mortality in both cases concentrated in young adulthood and adulthood (Figure 5).

Due to the lack of an age structure of the population in 1934 and 1940, the distribution of tuberculosis deaths per 100 deaths by age group has been calculated. Figure 6 shows that tuberculosis mortality was concentrated among specific age

[26]GSAS/YPA/YP917/Etesia, 1932.

Figure 6. Percentage of all deaths in each age group ascribed to TB, Hermoupolis, 1916–1940.
Note: The 1920 rate reflects the average number of deaths recorded between 1916 and 1924, the 1928 rate corresponds to the average from 1925 to 1931, the 1934 rate covers the period from 1932 to 1936, and the 1940 rate accounts for the average number of deaths and population data between 1937 and 1940. The rates were calculated around these years to facilitate comparisons with the national rates and due to data availability (i.e., the population at risk around the census years).
Source: Hermoupolis Mortality DATABASE.

groups. In 1934, compared to 1928, tuberculosis death rates increased in every age group, except for the very young and the very old. Young adults were notably affected in 1934, as in 1928, though the rates were much lower compared to those in 1920. By 1940, tuberculosis had declined further across almost every age group, except for the 15–29 age group, which showed persistently high percentages of tuberculosis-related deaths. While this analysis treats tuberculosis infection as a singular phenomenon, it is important to acknowledge that the disease can arise from various processes: primary infection, reinfection, or the reactivation of latent infections (see, for instance, Vynnycky and Fine 1997). However, the limitations of this dataset prevent further examination of any of these mechanisms.

Throughout the period for which cause-of-death information is available, tuberculosis had an important impact on the most active part of the labor force (i.e., young adults) in Hermoupolis. It is possible to hypothesize that workers in the textile manufacturing industry, Hermoupolis's primary industry at the time, and those employed in other factories faced a higher risk of tuberculosis mortality due to increased exposure to the transmission caused by overcrowding and unhealthy

Table 1. Percentage distribution (%) of Tuberculosis (TB) and All deaths by socioeconomic status (HISCLASS, categories adopted) in Hermoupolis, 1916–1940

	Socioeconomic status	HISCLASS	%TB deaths	%All deaths
Manual Workers	Unskilled	11–12	45.3	45.6
	Low skilled	9–10	14.8	12.6
	Farmer	8	1.8	1.8
	Skilled	6–7	14.2	15.3
Non-manual workers	Low/medium skilled	4–5	19.2	18.2
	Higher occupation	1–3	4.7	6.5

Source: Hermoupolis Mortality DATABASE.

working conditions. An examination of tuberculosis mortality across occupational groups, as shown in Table 1, reveals that the highest proportion of tuberculosis deaths occurred among unskilled workers (45 percent), followed by low/medium-skilled workers (19.2 percent), low-skilled workers (14.8 percent), and skilled workers (14.2 percent). However, it is evident that the occupational risk of tuberculosis mortality mirrored the overall pattern of all-cause mortality among these groups.

When analyzing tuberculosis mortality by sex and age group, it should be noted that the number of deaths within each category was relatively small, and therefore, caution should be exercised when analyzing the results by sex. However, tuberculosis mortality was consistently higher among men (Figure 7). While tuberculosis mortality declined for both sexes, the decrease was more pronounced among women than men. In 1920, female tuberculosis mortality was concentrated in infancy, adolescence, and very early adulthood. By 1928, the peak shifted to infancy and the age groups 10–39 years. Among males, tuberculosis mortality was elevated across all age groups, with notably higher rates in adulthood and old age. In Greece, the age pattern of tuberculosis mortality was similar for both sexes until young adulthood, after which male mortality surpassed that of females. In 1928, although male tuberculosis mortality remained consistently higher, females peaked during young adulthood (20–39 years of age). In both Hermoupolis and Greece, tuberculosis mortality consistently peaked in young adulthood for both sexes, affecting the most economically active part of the population. In Patras, tuberculosis predominantly affected males across all age groups, particularly those aged 21–30, while women were most affected between the ages of 11 and 20 (Eliopoulos 2010, 264–71). Similarly, in Volos, tuberculosis mortality was concentrated in comparable age groups (Moustane 2014, 254, 256). However, no comparable data are available for rural Greece.

The high tuberculosis mortality among women in young adulthood may be attributed to the large number of women employed in textile manufacturing in Hermoupolis. According to Papastefanaki (2008b, 167), women made up 76 percent of the workforce in a single textile factory in Hermoupolis in 1920, most of whom were young adults. This hypothesis aligns with studies from Belgium and Scotland,

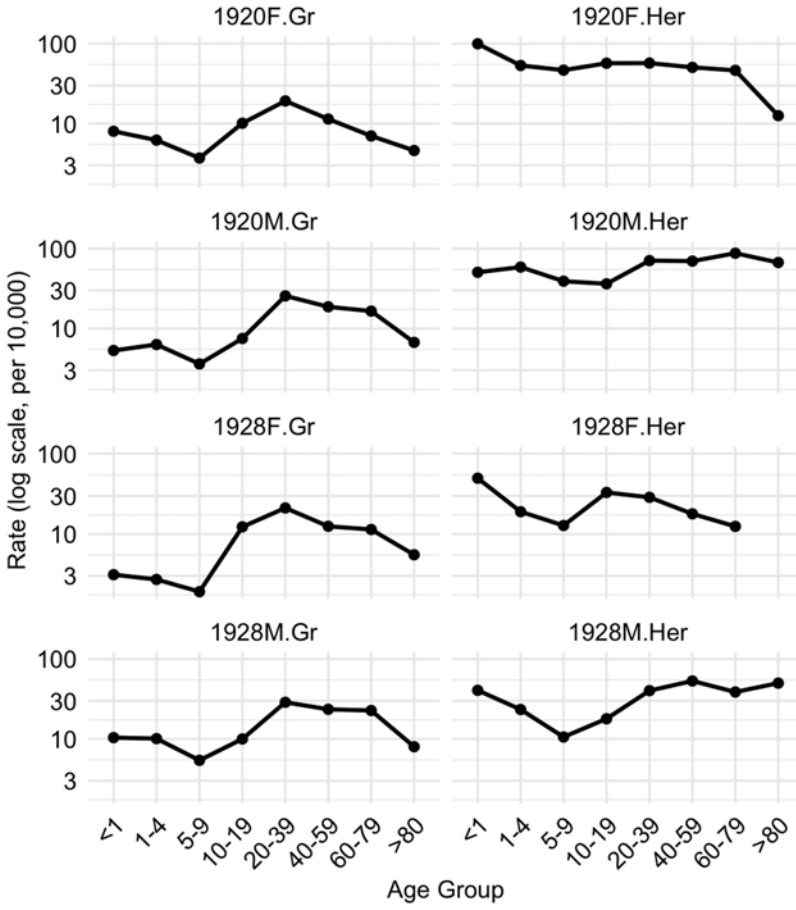

Figure 7. Age- and sex-specific mortality due to TB (all forms) in Hermoupolis and Greece, 1920 and 1928.
Note: Gr refers to Greece as a whole, based on published statistics, while Her refers to Hermoupolis based on individual-level death records.
Sources: Hermoupolis Mortality DATABASE; Greek censuses; Causes of death statistics (1921–1938).

where a predominance of young women in the textile labor force has been linked to high tuberculosis mortality or even excess female mortality (Devos 1996, 399–400; Reid and Garrett 2018, 125). Lastly, the idea that increased female tuberculosis mortality is related to an endemic nature of the disease or inherent biological susceptibility has found little support in the literature (McNay, Humphries, and Klasen 2005). Contemporary evidence further challenges this view, as males now exhibit higher prevalence and mortality rates from tuberculosis worldwide (Horton et al. 2016; 2018; Nhamoyebonde and Leslie 2014; World Health Organization 2022), a shift that seems to have occurred in the mid-twentieth century (Holmes, Hausler, and Nunn 1998).[27]

[27]For a recent review on gender differences in tuberculosis mortality, see van Doren (2024).

Conclusions

This article presented an analysis of tuberculosis mortality in Hermoupolis between 1916 and 1940. Contemporary estimates (Arfanes 1918; Fragkides 1894; Foustanos 1917; Rondopoulos 1917) suggested that Hermoupolis exhibited the highest levels of tuberculosis mortality in Greece. This study's findings, based on cause-specific mortality rates, confirm these high levels (Figures 1–4). The results show a significant decline in tuberculosis mortality by the end of the study period, although the underlying reasons for this decline remain unclear and require further investigation.

The article also examined tuberculosis mortality by age group and sex, revealing that mortality decreased across all age groups, particularly among females. Deaths were most concentrated in infancy, early adulthood (particularly between the ages of 20 and 39), and among the elderly (Figures 5–7). Additionally, the results indicated differences in tuberculosis fatality rates across occupational classes, although these differences closely mirrored those observed for all-cause mortality. The lack of sanitary reforms, poor living standards, nutrition, and overcrowding could have contributed to the high levels of tuberculosis mortality in the city.

In response to the high tuberculosis mortality rates, philanthropists and individual physicians attempted to address the gap left by the state and local authorities in Hermoupolis. However, the sanatorium established in 1919 had limited effectiveness, reflecting the general inefficacy of sanatorium treatment during this period. Further research is needed to investigate the factors behind the decline in tuberculosis mortality, including potential improvements in working conditions in factories (Stoyannides 2016; 2017; Papastefanaki 2008a; 2011), particularly in the textile manufacturing sector.

Future research should focus on establishing the levels of tuberculosis mortality in rural areas, which likely exhibited distinct patterns, as evidence from England and Wales has shown (Anderson 1990, 19; Hinde 2015, 369, 484; Woods and Shelton 1997, 109). Hospital registers could also provide valuable information on tuberculosis morbidity in Hermoupolis, offering insights into the age and sex distribution of fatalities. These data could potentially enable the examination of reinfection or reactivation triggered by other diseases. Examining changes in food consumption and their potential role in the decline of tuberculosis mortality in Hermoupolis, but also in Greece as a whole, is another promising avenue for study. Furthermore, comparative research on other Greek populations could shed light on the broader trends driving tuberculosis mortality decline in both Hermoupolis and Greece as a whole.

Finally, the story of tuberculosis in Hermoupolis highlights how health is deeply intertwined with societal conditions such as living standards, occupational environments, and public health efforts. By understanding the historical impact of this disease, we gain valuable lessons about the importance of addressing social inequalities to improve health outcomes, a challenge that remains relevant today.

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