# The fight against malaria in Sardinia at the turn of the 20th Century:
## a lesson for the present[1]

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### 1. Introduction

At the end of the 19th Century, Italian medical doctors were convinced that malaria was one of the most relevant factors affecting the diversified mortality distribution within the country[2]. As Snowden (2006, 3) mentions in his fascinating book dedicated to the conquest of malaria in Italy, the disease was so «enmeshed in Italian rural society that it was widely regarded as the 'Italian national disease', as the use, in other languages, of the Italian word malaria shows[3]».

Notwithstanding a huge amount of research dedicated to the presence of malaria in Italy[4], the role played by the disease in affecting the intensity of mortality and its cause specific structure during the health transition process has not been properly addressed and measured in the historical demographic research. This research gap is particularly relevant in the Sardinian case, considering that, at the end of the 19th century, with a population slightly above eight hundred thousand inhabitants, amounting to little more than 2% of the national population, about 15% of all the Italian deaths caused by malaria occurred in the island and this percentage in the following decades became even higher.

The absence of studies dedicated to the demographic burden of malaria is primarily the result of the limitations that characterise the official statistical sources and the lack of reliable and accurate information on the spread of the disease. Such failure reflects, however, also a number of more substantive issues about the extent of the demographic incidence of the disease, in terms of mortality (both direct and indirect) and morbidity that requires a specific analysis.

The information about the presence of the disease remained partial, inaccurate and limited for many years after national unification (1861). From 1887[5], the publication of cause specific mortality statistics began for each Italian municipality. However, the combined classification of deaths by age and

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cause is available nationwide, while at the regional level only for the years 1887 and 1888; on the other hand, it is never available at the provincial level.
Another important limitation of the cause-specific statistical data comes from the presence of a proportion of deaths attributed to unknown and undetermined causes, which is, in itself, an indicator of the quality of the data. This proportion was exceptionally high in Sardinia, much higher than the national average[6] and the incidence of this item appears to be particularly high for the youngest age groups[7], the most affected by malaria mortality, as we shall see.
Cases of malaria were not notifiable until the beginning of the 20th Century (and remained seriously underestimated until much later). Moreover, the destitute population living in the rural areas, which was the group most affected by the disease, had very little contact with medical doctors. Even after the advent of cause mortality statistics, «the incidence of malaria remained seriously underreported» (Snowden 2006, 8).

This article intends to fill this research gap, at least partially, and to estimate the demographic and health burden of malaria in the island of Sardinia, between the last decades of the 19th Century and the first decades of the 20th Century, emphasizing its peculiarities, in terms of both total intensity and structural characteristics in comparison with the rest of the country. In addition, the article aims to reconstruct the evolution of malaria mortality in Sardinia in the years before and during the first 'antimalaria crusade' (Snowden 2006, 53), documenting the relevance and the effectiveness of the sanitary campaign with the free distribution of quinine, as well as its limits and failures.

The period studied, in the choice of the initial data, is affected by the temporal limits of the available documentation, but it covers significant decades for the evolution of malaria mortality in the island. It includes, in fact, the phase that immediately followed the severe exacerbation of the disease, in the second post-unification decade, according to Tognotti (1996, 2008), but also the years of declining mortality, influenced by the quinine campaigns introduced from the beginning of the 20th century. The decline in malaria mortality, interrupted during the 1911 cholera epidemic, was reversed at the end of World War I and in the following years.

The article is organised as follows. In the next section, without neglecting the just mentioned difficulties arising from the quality of the statistical sources available, we analyse the first official statistics on malaria mortality in Sardinia and in the rest of the country as well as its structural characteristics by age and sex in 1887 and 1888, comparing the experience of the island with that of the other Italian most affected regions.

In the third section we describe malaria mortality trends in Sardinia (at the regional and provincial level[8]) and in the regions mentioned above, between national unification and the mid-twenties, providing a correction of the malaria mortality data and some interpretative comments on the tendencies observed.

## 2. The most malarious region in Italy: the epidemiology of malaria in Sardinia

Official malaria mortality is just one indicator of the real consequences of the disease. Medical science shows that for every death classified as a consequence of malaria there are several others classified as caused by other illnesses, which, however, are directly or indirectly related to malaria due to the process of physical weakness caused by the disease[9]. At the end of the 19th Century, Italian medical doctors were convinced that for each person that malaria killed, there were one hundred others whose physical and mental energies, and working capacities were depleted, and whose resistance to other diseases was lowered, immediately or later, by malaria (Bonelli 1966, 662). The physician and zoologist Giovanni Battista Grassi at the turn of the 19th Century stated that, to get an accurate estimate of the number of deaths caused (both directly and indirectly) by malaria, it would have been necessary to multiply the official figures by five (Snowden 2006, 120). Although this argument is plausible, the available data do not provide a precise empirical validation and it is necessary to rely almost exclusively on malaria specific mortality statistics.

In 1887, the first year of cause and age specific-mortality statistics available for the whole country, as mentioned in the introduction, the malaria mortality rate in Sardinia amounted to 3.1 deaths per thousand inhabitants, more than 4 times higher than the national average (0.7‰). All the other most affected regions were in the South (Basilicata: 2.6‰, Calabria: 1.9‰ and Sicily: 1.7‰). It should be noted that the number of malaria deaths recorded in the Kingdom that year (more than 21,000) remained a negative record never approached later (in 1888 the figure fell below 16 thousand and rose again to just above 18,000 only in 1891). In those years and until the end of the 19th century just over 10 deaths per 100 were officially caused by malaria in Sardinia, while the corresponding figure on average in the country was 2[10].

Already at that time only a limited part of the national territory, mainly concentrated in the South, was affected by malaria, while the disease was present in the large majority of Sardinian municipalities. The Survey on the health and hygienic conditions in the Kingdom (MAIC 1886), carried out at the municipal level in 1885, recorded only 46 Sardinian municipalities in Sardinia, out of a total of 364, as 'disease-free' (or with missing information). In 249 municipalities (with more than 2/3 of the island's population), malaria was frequent, and in 69 it was rare (29% of the Sardinian population).

The figures reported in the Survey are quite generic and relative and we should also take into account that, when the survey was carried out and then published, the collection of the data on causes of death had just been launched and only for the capitals of provinces and districts.

However, the subsequent data also confirm the primacy of the disease in Sardinia. In 1894, in fact, the General Directorate of Statistics (MAIC 1894) published the first exceptionally clear and detailed malaria mortality map,

(based on malaria deaths recorded in three years 1890-92) in the Italian municipalities. In Sardinia there was the highest concentration of the most severely malaria affected municipalities.

In the early 1920s, the entire population of Sardinia was still officially exposed to the risk of contracting malaria[11]. Early 20th Italian legislation had established, in fact, specific criteria for the identification of 'malarial' areas in the Kingdom, which was to be carried out by the provincial doctors and engineers of civil Cadastre (Ministry of Interior 1924, 11)[12].

The extreme gravity of malaria in Sardinia at the beginning of the period is reflected in the intensity and the structure of malaria mortality by sex and age. Table 1 shows malaria mortality rates by age in Sardinia, in the other most affected Italian regions and in the Kingdom in 1887-1888[13]. Analysis of this table reveals some specific features of the age profile of malaria mortality in Sardinia and shows the concentration of the highest number of deaths in childhood, adolescence and early youth recorded there. The very high risk of death in the first year of life, more than 4 times higher than the corresponding rates recorded in Sicily, Calabria and Basilicata (the other most affected regions) draws our attention.

In Sardinia, almost 2/3 of malaria deaths (over 64%) involved children less than five-year old (74% under ten years). In the other most affected regions, the proportion of malaria deaths in the young-adult ages is much larger (50% of deaths over age 15).

The doctors involved in the Sardinian 1911 anti-malaria campaign wrote: «The prevalence of infection mostly affects babies, especially in the first months of life. We got the impression that malaria is an infant disease, such as measles and whooping cough» (Lustig, Sclavo 1912, 66).

The lethality of the disease depends on the type of Plasmodium: Plasmodium Falciparum (which was very common in Sardinia) is much more lethal. It can kill, at the first attack, especially the babies and very young children. On the contrary, Plasmodium Vivax lethality does not exceed 5%.

The latter, however, through the mechanism of recurrences, progressively debilitates the individual making him/her more vulnerable to other infections. A malaria attack may a) evolve more unfavourably in the event of another infection occurring and b) aggravate other on-going infections. On the other hand, children of mothers affected by malaria were often born underweight and, even when they did not contract the disease, they were exposed to particularly high risk of death caused by respiratory and gastrointestinal infections when the protection of breastfeeding was over (after the first year of life) and this could explain the more elevated risk of death in the second year of life in Sardinia attested by the sources of the time (Coletti 1911).

The higher incidence of malaria mortality amongst infants and children in Sardinia presumably derived from the stronger exposure to the risk of contracting the infection and the epidemiological characteristics of the disease

in the island. The age pattern of malaria mortality caused by plasmodium falciparum varies depending on the severity of malarial infection. As recent studies show (Carneiro *et al.* 2010)[14], the higher the intensity of malaria transmission, the more the burden is shifted to infancy and childhood. It is a complex relationship, mediated through malaria seasonality.

Tab. 1. *Malaria mortality rates in Lazio, Abruzzi, Campania, Calabria, Basilicata, Sicily, Sardinia and the Italian Kingdom in 1887-888 (‰)*

| Age groups | Lazio | Abruzzi | Campania | Apulia | Basilicata | Calabria | Sicily | Sardinia | Kingdom |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 2.7 | 3.2 | 1.9 | 3.7 | 5.5 | 5.8 | 6.1 | 22.4 | 2.6 |
| 1-4 | 2.3 | 2.4 | 1.5 | 2.8 | 5.1 | 3.6 | 4.7 | 10.2 | 1.7 |
| 5-19 | 0.5 | 0.7 | 0.3 | 0.8 | 1.2 | 0.9 | 0.9 | 1.6 | 0.3 |
| 20-39 | 0.6 | 0.5 | 0.3 | 0.7 | 1.0 | 0.9 | 0.5 | 0.7 | 0.3 |
| 40-59 | 0.8 | 0.8 | 0.4 | 1.0 | 1.6 | 1.4 | 0.9 | 1.1 | 0.4 |
| 60+ | 1.8 | 2.3 | 1.2 | 2.3 | 3.6 | 3.6 | 2.2 | 3.4 | 1.0 |
| Total | 1.0 | 1.1 | 0.6 | 1.3 | 2.1 | 1.7 | 1.5 | 3.0 | 0.6 |

Source: MAIC, Direzione Generale della Statistica, (1890); MAIC, Direzione Generale della Statistica (1883; 1904).

This aspect was already clear to the doctors and hygienists engaged in the first antimalarial campaigns in Sardinia, who in fact wrote: «the complexity of malaria epidemiology in Sardinia also stems from the fact that in the island plasmodium falciparum and plasmodium vivax coexist and multiple infections are frequent. Plasmodium vivax has an incidence consistently high during the year, which explains the nature of the disease permanently endemic in the island. Plasmodium vivax affects mainly children and is characterized by high morbidity rates, but low mortality. On the contrary, as we have observed, plasmodium falciparum, the most deadly strain, has unstable annual incidence and a more markedly seasonal nature, which explains the epidemic malaria trend in the late summer and early autumn. The extent of the epidemic annual trend is linked to the ecological characteristics, as for example, the amount of summer rainfall, etc.» (Lustig, Sclavo 1912, 66).

Also more recent information referring to the malaria experience in Sardinia seems to confirm this interpretation. Given the high prevalence of malaria, Sardinia was chosen for the realization of the ERLAAS project, led by the Rockefeller International Health Foundation between 1947 and 1951[15]. Thanks to the ERLAAS campaign and its long period of preparatory activity[16] in the previous decades, for Sardinia we have at our disposal a large amount of data on the epidemiology of malaria and the entomology of the Anopheles

labranchiae vector[17] (Brown 1981, 317). Taking advantage of this rich wealth of information, Brown, in his doctoral dissertation (1979) and in several subsequent articles, has described the epidemiology and the seasonal cycle of malaria in the island. He argued that in the island it was impossible to achieve the immunisation against Plasmodium falciparum, which was common in tropical climates as a result of the local malaria seasonality, since only being constantly exposed to the disease made it possible to gain immunity.

This greater intensity of the disease transmission in the island, compared to other malarial regions of the Kingdom is confirmed by a lower mortality gender differential (see tab. 2).

In all age groups, we find in Sardinia a more balanced mortality[18], with the partial exceptions of the central ages, while in the other most affected regions as well as at the national level, we observe a more marked disparity at the young adults ages, with higher risks of death for males. The table confirms that malaria in the island killed infants, children and young adults of both sexes (0-19 years) in a much higher proportion than in the rest of the country, while in the following age groups the intensity of malaria mortality as well as the gender gap were even lower than in the other regions.

To assess the health and socio-economic burden of malaria, in addition to its strictly demographic impact, it would be necessary to know not only the number of malaria deaths, but also that of the individuals affected by the disease. Unfortunately, the statistics in this respect underestimate the number of cases in Sardinia as well as in the rest of the country, despite the fact that at the beginning of the twentieth century, malaria became a "compulsorily notifiable" disease, according to Italian law[19].

Snowden (2006, 124-126) illustrates – with explicit references to Sardinia – the great imprecision of morbidity statistics[20], highlighting various important reasons for such approximation. The author recalls the major difficulty in the diagnosis of the disease among children, mentioned by the Italian physician Grassi. According to Grassi, in fact, children did not show the same symptoms as adults, experiencing fever without chills and sweating. Since in those times almost no doctor had access to a microscope, children's disorders were often attributed to indigestion, teething, intestinal parasites and to rheumatic fever, or, at worst, were simply neglected (Snowden 2006, 94).

Snowden documents other difficulties related to the fact that patients often preferred to ignore the milder cases of the disease or decided to treat themselves without consulting a medical doctor. In some Italian regions, there were remote areas without medical assistance (very frequent in the interior of Sardinia) in which even the most seriously ill individuals had no health care. Finally, he mentions that the physicians, often overburdened, tended to treat patients without losing time in completing the paperwork required by law (i.e. notification of the disease, etc.).

Tab. 2. *Age and sex-specific malaria mortality rates (per thousand) in Sardinia, Basilicata, Calabria and in the Kingdom in 1887-1888*

| | Sardinia | | | Basilicata | | |
|---|---|---|---|---|---|---|
| | M | F | Ratio M/F% | M | F | Ratio M/F% |
| 0 | 22.5 | 22.3 | 101.1 | 5.9 | 5.1 | 116.8 |
| 1-4 | 10.4 | 10.1 | 103.7 | 5.4 | 4.8 | 112.7 |
| 5-19 | 1.6 | 1.7 | 93.7 | 1.2 | 1.0 | 124.4 |
| 20-35 | 0.6 | 0.7 | 91.6 | 1.3 | 0.8 | 149.8 |
| 40-59 | 1.2 | 1.0 | 129.3 | 1.8 | 1.4 | 133.2 |
| 60+ | 3.2 | 3.6 | 88.5 | 4.3 | 3.0 | 144.5 |
| Total | 3.0 | 3.0 | 99.5 | 2.3 | 1.8 | 130.9 |
| | Calabria | | | Kingdom | | |
| | M | F | Ratio M/F% | M | F | Ratio M/F% |
| 0 | 5.9 | 5.6 | 104.5 | 2.6 | 2.6 | 102.8 |
| 1-4 | 3.6 | 3.5 | 103.4 | 1.7 | 1.7 | 100.9 |
| 5-19 | 1.0 | 0.8 | 123.2 | 0.4 | 0.3 | 122.4 |
| 20-35 | 1.3 | 0.6 | 204.3 | 0.3 | 0.2 | 145.6 |
| 40-59 | 1.8 | 1.1 | 155.6 | 0.5 | 0.3 | 159.8 |
| 60+ | 3.9 | 3.4 | 116.3 | 1.1 | 1.0 | 115.3 |
| Total | 2.0 | 1.5 | 131.2 | 0.7 | 0.6 | 120.0 |

Source: MAIC, Direzione Generale della Statistica, Volumes on Causes of Deaths Statistics (1890); MAIC, Direzione Generale della Statistica, Population Censuses, 1883; 1904[21].

### 3. The sanitary campaign against malaria in Sardinia and the evolution of mortality (1887-1923)

The official survey on malaria carried out by the General Directorate of Statistics (Ministero dell'Interno 1924, 1925) leave no doubt about the severity of malaria in the island (see tab. 3).

In the table we have included, for the regions most affected by the disease and the Italian Kingdom, the official malaria-mortality rates, according to the surveys and our 'amended' rates calculated in order to mitigate the biases deriving from the different proportion of deaths due to unknown or not identified causes of death recorded in the regions, mentioned in the first section.

The correction for each region and the Kingdom has been made attributing to malaria an additional proportion of those deaths that had been classified under the heading 'unknown cause or indefinite', using the same proportion of malaria deaths calculated on the total number of deaths with known cause. This

correction, while maintaining certain arbitrariness, still appears plausible and necessary to measure more correctly malaria mortality impact. Taking into account the age distribution of deaths with unknown or indefinite cause[22], available nationwide, it would not be unreasonable to further adjust upward the number of deaths caused by malaria, but we preferred to opt for a standard procedure, commonly used in demography.

Tab. 3. *Malaria mortality rates (per 100,000) in Sardinia, Basilicata, Calabria, Sicily and the Italian Kingdom (1887-1923) according to official statistics and amended*

| Years | Sardinia | Basilicata | Calabria | Sicily | Kingdom |
|---|---|---|---|---|---|
| | | | Official | | |
| 1887-1890 | 301 | 187 | 156 | 132 | 58 |
| 1891-1895 | 261 | 226 | 125 | 117 | 53 |
| 1896-1900 | 246 | 170 | 94 | 76 | 40 |
| 1901-1905 | 162 | 156 | 70 | 30 | 30 |
| 1906-1910 | 71 | 45 | 34 | 34 | 12 |
| 1911-1915 | 97 | 32 | 21 | 22 | 9 |
| 1916-1920 | 162 | 121 | 29 | 34 | 20 |
| 1921-1923 | 98 | 43 | 31 | 26 | 11 |
| | | | Amended | | |
| 1887-1890 | 337 | 193 | 165 | 136 | 59 |
| 1891-1895 | 304 | 233 | 134 | 121 | 54 |
| 1896-1900 | 279 | 174 | 98 | 91 | 41 |
| 1901-1905 | 178 | 160 | 73 | 70 | 30 |
| 1906-1910 | 74 | 46 | 34 | 34 | 12 |
| 1911-1915 | 101 | 33 | 22 | 22 | 9 |
| 1916-1920 | 172 | 126 | 29 | 35 | 21 |
| 1921-1923 | 104 | 44 | 32 | 27 | 11 |

Source: Ministero dell'Interno e Ministero dell'Economia nazionale, 1925, 235-236; MAIC, Direzione Generale della Statistica, Volumes on Causes of Deaths Statistics (1890)[23]; MAIC, Direzione Generale della Statistica, Population Censuses, 1883; 1904.

The correction is more relevant in the Sardinian case. As noted above, the classification of deaths is far more problematic there than in all the other Italian regions, as a result of an exceptionally high proportion of deaths due to unknown or not identified causes of death, which at the end of the 19th century even reached peaks of over 14%, with the risk of distorting malaria mortality trends (particularly in the province of Cagliari).

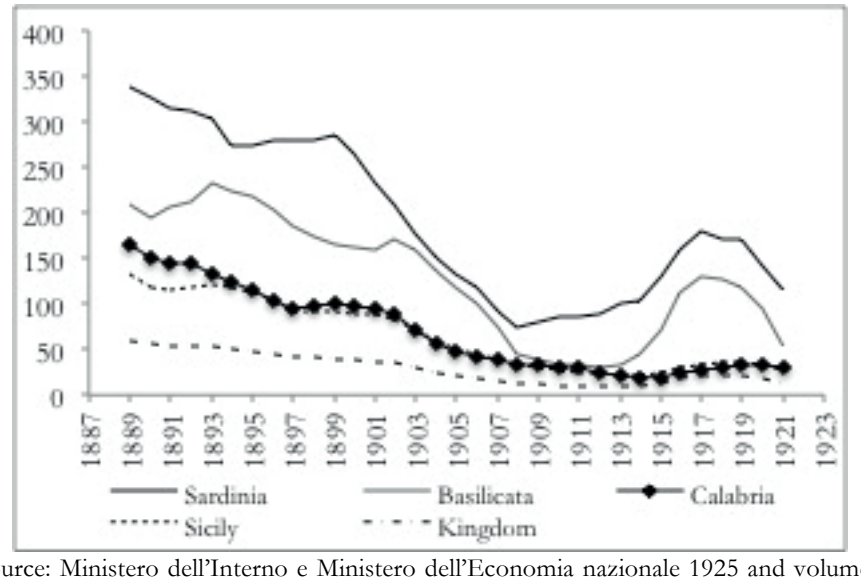
Regardless of the data we used, only Basilicata presents rates that, in some periods, are close to those registered in Sardinia. We found an alignment between the two regions, particularly in the early years of the 20th century: the process of mortality reduction caused by malaria seems, in fact, more contrasted, and slow in Basilicata, at least in the first phase where even an increase in malaria mortality is recorded.

Since the early years under consideration, we observe a decrease in mortality in Sardinia, as in the rest of the Kingdom – with the exception of Basilicata- well before the launch of the quinine campaign that began in the early twentieth century, even if there were various years of recrudescence.

Hackett (1937, 228), reporting the opinion of Angelo Celli, mentioned «waves of increased malaria endemicity in Italy» recorded every five or six years, and cited 1887 and 1891, as years of increasing deaths, assuming a relationship between malaria resurgence and weather conditions: wet spring followed by very hot summers. The first would encourage mosquitoes while the second plasmodia. The increased malaria epidemic waves, referring to Sardinia and Basilicata, appear very clearly in figure 1 that also allows us to observe an abrupt reversal during the World War I (Snowden 2006, 104-105).

The correction causes mitigation of the apparent marked reduction in malaria mortality that occurred, according to the official statistics, before the great campaign of free distribution of quinine and further accentuates the gap between Sardinia and the southern regions.

Fig. 1. *Amended malaria mortality rates (per 100,000) in Sardinia, Basilicata, Calabria, Sicily and the Italian Kingdom (1887-1926), 5-year moving averages*



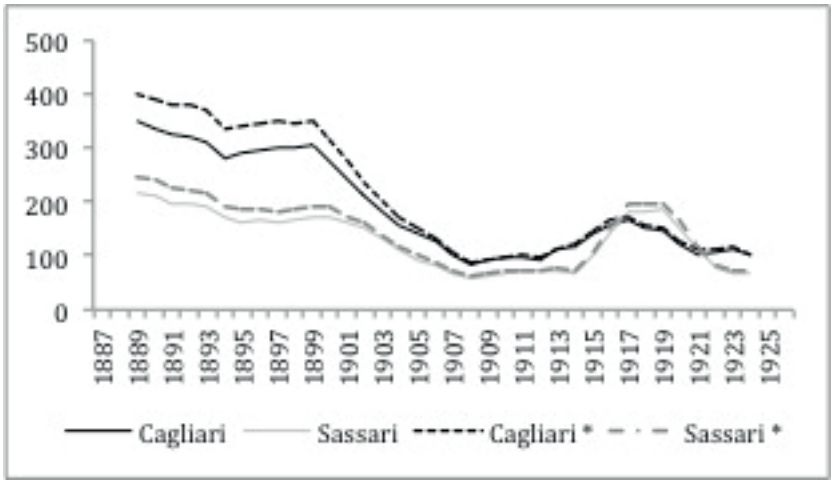

Source: Ministero dell'Interno e Ministero dell'Economia nazionale 1925 and volumes on Causes of Deaths Statistics[24].

The trend of malaria mortality, observed in the region, reflects very similar trends in the two Sardinian provinces (see. fig. 2) with the maintenance of a gap in favour of Sassari, reversed only in the 1917-1920 years. The Sardinian provinces were always in the highest rankings of Italian malaria mortality.

The official rates, and the amended ones even more, highlight a significant exacerbation in the years of World War I and after the conflict, already documented at the national level, but particularly acute in Sardinia, especially in the province of Sassari. In both Sardinian provinces, in the three year-period 1915-17 malaria mortality rate was more than double the rate observed in the aftermath of the quinine campaign (1906-08). Still in the early twenties, the values recorded before this abrupt turnaround had not yet been regained. Malaria mortality rate in the island was, in fact, around 100 deaths per 100,000 inhabitants (with the official values and also with the amended ones), while the corresponding mean national figure was 11 deaths per 100,000 inhabitants.

The very serious resurgence of malaria during the war[25] has been attributed to a number of factors, including the general deterioration of health conditions and the reduced supply of quinine, due to the sharp rise in prices and the war priorities[26]. The massive involvement in the rural work of women and children, previously better protected has also been highlighted. Other factors worth of consideration are the difficulties in organizing the fight against the disease due to the funding reduction and the sending of doctors and nurses, previously involved in the health stations, to the front to assist soldiers.

Fig. 2. *Official and amended (*) malaria mortality rates in the Sardinian provinces, 5-year moving averages (1887-1926)*




Source: MAIC, Direzione Generale della Statistica, volumes on Causes of Deaths and volumes on *Movimento della Popolazione e Stato civile*.

After the war, the official opinion expressed by the Health General Directorate tended to shed light on the positive effects of the work carried out by the Directorate and the results achieved (Ministero dell'Interno 1924, 22-23), without paying attention to the increase in malaria mortality during the war, nor analysed the reasons for the general deterioration of the population's health conditions in those years.

However, numerous testimonies of the time document that the significant reduction in the number of deaths directly attributed to malaria in the years before the World War I was not accompanied by a comparable reduction in the number of the disease cases. Unfortunately, as already mentioned, the quantitative information about the number of disease cases is very deficient.

Among the many testimonies, which highlight different trends in malaria mortality rates and morbidity rates, we can mention, by way of example, a study carried out in the province of Sassari in the years immediately preceding the war, 1909-1913, by the provincial doctor, Lazzaro Trincas (1914). In the first lines of his study, Trincas declared that he had been urged to analyse statistical data on mortality and morbidity in the municipalities of the province of Sassari because in the talks he had had in the summer of 1913 with the municipal health professionals, he had been struck by the fact that «while a part of them unanimously stated that the epidemic over the previous year was less intense or almost equal in the number of cases, another part claimed the opposite, a resurgence of malaria morbidity, with the manifestation, in some locations, of severe clinical forms» (Trincas 1914, 5).

Trincas, according to the statistical data available, drawn from the daily records and the reports of the doctors responsible for the antimalarial service in the province of Sassari, emphasized that in the course of 1913 a total number of 24,259 cases of malaria out of a population of 329,510 inhabitants had been registered throughout the province with a morbidity rate of 7.3%. Comparing that value with the rates recorded in previous years (1909-12), Trincas brought to light substantial stability («oscillations of little importance») in morbidity, in the presence, however, of a significant reduction in mortality. The analysis he had undertaken in 1913, led him to recognise a gradual decrease in mortality as well as in other epidemic indices, such as recidivism and perniciousness; «however serious forms continue to prevail over mild ones; the same infection keeps up its diffusion index with slight fluctuations in individual years and alternates attenuations and outbreaks in the various municipalities» (Trincas 1914, 15).

Our estimates on morbidity referring to the Province of Sassari for the years 1903-1918, which have to be considered with great caution for the reasons mentioned above, show a parallel increase in both the number of cases and in the number of deaths, with an apparent stability in the morbidity rate, as well as in the lethality[27]. The stability in the morbidity rates could be an artefact due to improved coverage in the notification of cases of illness, but all the information and testimonies of the time seem to confirm these trends.

Tab. 3. *Total number of malaria cases and total number of deaths in the province of Sassari (1903-1918)*

| Years | Malaria Cases | Morbidity rate % | Malaria Deaths | Deaths per 1,000 cases |
|---|---|---|---|---|
| 1903 | 18163 | 5.8 | 313 | 17.2 |
| 1904 | 27316 | 8.6 | 413 | 15.1 |
| 1905 | 27883 | 8.6 | 385 | 13.8 |
| 1906 | 21370 | 6.5 | 244 | 11,4 |
| 1907 | 27923 | 8.4 | 164 | 5.9 |
| 1908 | 14491 | 4.3 | 163 | 11.2 |
| 1909 | 13804 | 4.0 | 178 | 12.9 |
| 1910 | 20674 | 6.0 | 232 | 11.2 |
| 1911 | 24300 | 7.1 | 367 | 15.1 |
| 1912 | 23200 | 6.9 | 228 | 9.8 |
| 1913 | 24259 | 7.2 | 203 | 8.4 |
| 1914 | 15561 | 4.6 | 175 | 11.2 |
| 1915 | 27982 | 8.2 | 272 | 9.7 |
| 1916 | 20030 | 5.9 | 261 | 13.0 |
| 1917 | 41922 | 12.3 | 782 | 18.7 |
| 1918 | 39330 | 11.6 | 939 | 23.9 |
| 1919 | 30454 | 9.0 | 815 | 26.8 |
| 1920 | 43703 | 13.0 | 303 | 6.9 |

Source: Tognotti and De Franceschi (2000, 318); Snowden (2006, 122) and MAIC, Direzione Generale della Statistica, Causes of Death volumes and volumes on Movimento della Popolazione; Tognotti (2008, 224).

The Director of the Institute of Hygiene of the University of Rome, Senator Sanarelli (1925, 10) in a publication produced under the auspices of the Organising Committee of the Southern and Insular Land Reclamation Consortia, wrote with reference to the 1920s that «the less pessimistic calculations do ascend the number of malaria affected individuals, in Italy, to well over two million» – on a total population of just under 40 million. He continued in the same publication, stating: «We have long believed that a diligent distribution of quinine to all malaria affected individuals could also constitute a valuable element of prophylaxis […]. Of course, after low-priced State quinine became widely available, the cases of pernicious malaria and cachexia that once gave the greatest contribution to the high quotients of malaria mortality fell sharply. However, as to morbidity, which, socially has far greater importance than mortality, we must have the courage to confess that our conditions are still very pitiful» (Sanarelli 1925, 16).

Also Snowden (2006) shared this opinion; while acknowledging that the antimalarial programme enabled a number of positive results, he indeed argues that the programme failed its ultimate goal, which was the final defeat of the disease. Citing the American epidemiologist Fred Soper who claimed that malaria enslaves those it does not kill, Snowden (2006, 93) wrote: «The drama

for Italy was that even as malaria ceased to kill, it continued to enslave» (Snowden 2006, 93).

Reducing the number of malaria deaths, while allowing important gains in survival, did not permit an effective improvement in Sardinian population's health, which was greatly weakened by the conflict, as attested on the other hand, by further indicators, such as the resurgence of trachoma (Melis and Pozzi 2013) and the strong increase in mortality due to tuberculosis (Collari 1935), which had started already at the beginning of the twentieth century.

## 4. Conclusions

The analysis conducted has allowed us to illustrate, notwithstanding significant limits related to the available statistical data, the exceptional importance that malaria played in the Sardinian health transition process, between the end of the 19th century and the first decades of the following century. In no other Italian region, did malaria have such a significant impact, with the partial exception of Basilicata and Calabria.

In the island mortality due to malaria, at the beginning of the period analysed, was more than 4 times higher than the national average. Deaths caused by the disease amounted to more than 10% of the total amount, against an average rate of about 2% recorded for the whole country. Furthermore, using the statistical data available for the two-year period 1887-1888, which provides the combined classification of deaths by cause, sex and age, hitherto used to a very limited extent, the peculiarity of age-specific malaria mortality in the island was illustrated. Exceptionally high death risks in the first age groups (almost 2/3 of malaria deaths involved children less than five years old) were recorded in the island together with an overall balance between the sexes. These peculiarities have been explained on the basis of the epidemiological characteristics of the disease in the island. In particular, the age pattern of malaria mortality and its exceptional burden amongst infants and children could be explained by the exceptional severity of malaria infection caused by the very frequent presence of plasmodium falciparum and the seasonal characteristics of the disease in the island.

The significant decrease in malaria mortality taking place in the country from the end of the 19th Century was followed by a very serious resurgence of malaria mortality, particularly accentuated in Sardinia, in the years around the World War I. This malaria mortality flare-up was a consequence of the reduced availability of quinine and, more generally, of the deterioration in the living conditions of the population during the epidemic and the war, but in our opinion it was also clear evidence of the contradictions and limits of the quinine-campaign, and more generally, of a purely therapeutic approach.

According to the qualitative medical sources of the time, the health interventions put in place in the initial phase of national mobilization against malaria, while allowing an overall reduction of malaria-mortality, were insufficient to ensure the necessary effective improvement of the general living

conditions and health status of the population, especially in the areas more inaccessible and poor on the island of Sardinia. Those areas were characterised by the absence or the very limited presence of medical doctors, and health services and infrastructures, as well as by a mostly illiterate population, characterised by a condition of 'physiological poverty' – as the medical doctors of the time used to remark- due to a complex of diseases, directly resulting from misery and deprivation. The hygienists involved in the antimalarial campaigns (Lustig, Sclavo, Alivia 1911; Lustig, Sclavo 1912) emphasized the need for a unitary health action against this complex of pathologies, not exclusively based on the distribution of quinine, reiterating the need to provide the population with better nutrition, more dignified sanitary conditions and the indispensability of an education programme. Regarding this final recommendation, they offered many vivid testimonies on the difficulties encountered in the administration of quinine, caused by the population's extreme suspicion and lack of trust in doctors.

The sharp worsening of malaria mortality in the years of the World War I in Sardinia made clear the limits of the fight against the disease carried out in the first decades of the twentieth century, although it was in those years that the pre-conditions for the ultimate success, in many respect, were created.

We should take into account, in fact, what Snowden (2006) named «the legacy of literacy, medicalization, and antimalarial propaganda in the countryside of Sardinia». As mentioned before, the medical doctors involved in the first antimalarial campaigns, reported that one of the major obstacles they encountered in their fight against the disease was the ignorance and suspicion of the population. «During the establishment of rural health stations and schools in the early years of the twentieth century, Sardinian peasants and shepherds widely suspected that the physicians who sought to treat them were actually poisoners. Half a century later, however, ERLAAS reported that the descendants of those who had so fiercely resisted quinine now warmly accepted DDT even when it was sprayed in their homes and in the waterways that they depended on for their own survival and that of their flocks. Here one detects the success of the malaria physicians, the rural schools, and the health stations in their fifty-year campaign to create a 'sanitary consciousness' and a relationship of trust between doctors and their patients […] ERLAAS itself built on this legacy by carrying out an educational mission of its own» (Snowden 2006, 207).

More generally we can observe that the doctors engaged in the campaigns against malaria in Sardinia had indeed comprehended quickly that malaria there was linked to the social and economic condition of the population and that it was therefore impossible to fight against the disease with only quinine, drainages and 'specific resources' (Lustig *et al.* 1911, 4).

The experience of Sardinia offers the most effective testimony of the main lesson that we can draw from the past for the current challenge represented by

malaria in the poorest countries, and proves what has been observed more generally for the whole of the Italian nation «that malaria and poverty were so interwoven that in order to defeat either plight, they must be attacked simultaneously» (Amorosa *et al.* 2005, 72).

[1] The article is written within the Coordinated Research Project 'Health Disaster and International Cooperation in Time of Crisis. Europe 1918-1945' (MINECO-HAR2017-82366-C2-1, 2018-2021) and more specifically it refers to the sub-project *Past and present in the control of neglected poverty diseases: the historical example of Mediterranean Europe and international health cooperation.* The authors would like to thank George Whitley Radcliffe for his kind help in the linguistic revision.

[2] See for instance Sormani (1881, 332) who attested higher mortality rates in the Italian regions where malaria raged more severely. Also Snowden (2006, 15-16) provides other testimonies of the time in the same direction.

[3] The word mal'aria means 'bad air' in Italian and reflects the most ancient conception of the disease, which was associated with the exhalations of harmful air by Hippocrates in the 5th Century B.C. Similarly, the roman medical doctor Galeno, in the second Century B.C considered the marshy miasmas responsible for the disease (hence the term 'paludismo').

[4] It is virtually impossible to propose even a partial review of the studies on the presence of malaria in Italy. Here we mainly provide bibliographic references referring to the Sardinian experience, although we shall refer also to few some more general works that deal with aspects relevant to the proposed analysis.

[5] The publication of the causes of death statistics began in 1881, but only with reference to the provinces and the district-capitals. The volumes of the official Italian statistics were published by Direzione Generale della Statistica (General Directorate of Statistics) of Ministero dell'Agricoltura, Industria e Commercio (MAIC) for the years of 1887-1914. The Statistical Office responsible for the publication and the Ministry of reference changed in the following years. For the sake of brevity, in the bibliographic references we have included only the title of the first volume of the official statistical publications used with reference to both the causes of death statistics and the civil records (*Movimento della Popolazione* secondo gli atti dello stato civile), whose titles also changed slightly over time.

[6] In Sardinia the proportion of deaths due to unknown cause increased up to 14% in the late nineteenth century (when the average of the Kingdom was less than 2%), then decreased sharply, but remained higher than the average values recorded at the national level.

[7] On average, excluding exceptional years (eg, 1918, during the Spanish flu, or during the war) a share not less than 40% of deaths whose cause remained unknown referred to children under the age of 5 years.

[8] Until 1926 the island territory was divided into only two provinces: Sassari, in the north, and Cagliari in the south. In 1927 the new province of Nuoro was created which included districts belonging to the two more ancient ones.

[9] On the interactions between malaria and other infections see the interesting considerations included in the section dedicated to this specific topic by Sallares (2002, 123-140).

[10] In the early twenties the corresponding figures would become 4 in Sardinia and 0.6 in the Kingdom.

[11] According to the survey of 1924 (Ministero dell'Interno 1924, 12), in 1922 on December 31, 2616 Italian municipalities, out of a total of 8362 (29,32%) included areas classified as malaria affected; in 995 of these municipalities, the 'malaria-condition' was extended to the entire territory including the municipal town. In Sardinia on a total of 364, only two municipalities in the province of Sassari were classified as malaria free. Almost the entire population of the island was residing in malarious areas (859,141 individuals out of a total number of 866,681 residents).

[12] The statement, which attested «for the resident population the possibility of contracting malaria fevers regardless at their intensity and the number of cases» (Ministero dell'Interno, 1924: 12), was the essential precondition for the application of the «special anti-malaria providences» and the free quinine distribution.
[13] The denominators of the regional malaria mortality age specific rates for the years 1887-1888 have been derived by interpolation using the Population Censuses of 1881 and 1901 (MAIC 1883; 1904). The same procedure has been followed for the calculation of the corresponding age and sex specific rates reported in Table 2.
[14] The article by Carnero et al. (2010) also contains a review of the studies in this regard.
[15] Unfortunately, we do not have at our disposal similar detailed data relating to other Italian regions and therefore it is not possible to corroborate our hypothesis according to which the higher malaria mortality observed in Sardinia in comparison with other Italian regions was connected to its specific epidemiological characteristics.
[16] The contacts between the Rockefeller Foundation and the Italian Government, directed to the fight against malaria, started much earlier and intensified from the beginning of the twenties. On these issues, see Donelli, Serinaldi 2003.
[17] The acronym ERLAAS derives from the name of the *Regional Agency for the Anti-Anopheles Struggle in Sardinia (*Ente Regionale per la lotta anti-anofelica in Sardegna*)*.
[18] Women in Sardinia were not spared by the disease, but they were «all pale as ivory, and even the most beautiful, the finest, with the gaunt chest and the stomach swollen by malaria fevers», as the 1926 Sardinian Nobel Prize in the literature, Grazia Deledda, wrote in her famous novel *Canne al Vento*, published for the first time in 1913.
[19] In Sardinia the recorded cases at the beginning of the 20th Century would have corresponded to 1/5 or even 1/7 of the cases which actually occurred.
[20] Other scholars have identified additional difficulties in identifying malaria as a cause of death, due to lack of medical consultation for the treatment of the disease, but also suggested that there might have been hesitations on the part of doctors. Corbellini and Merzagora (1986, 86) argue that for the medical doctors it was difficult to distinguish an early infection (primitive) from relapse or reinfection. In addition, they often did not report malaria as a cause of death; the availability of an effective remedy as quinine, made them, in presence of a death, suspected of neglect in diagnosis or treatment.
[21] See note 12.
[22] As mentioned, the proportion of deaths in the first five years of life due to unknown cause remains stable during the considered period, an average of more than 40% of the total. The only exceptions are recorded during exceptional events (World War I, the Spanish epidemic, etc.) when the proportion of indeterminate age increases considerably.
[23] See note 4 for the bibliographic references of the volumes on the causes of death.
[24] The denominators of the Sardinian provincial malaria mortality rates have been derived from the annual provincial population data included in the volumes of *Movimento della Popolazione* (MAIC 1889 and following).
[25] See in this regard the acute and documented analysis of Snowden, who dedicated an entire chapter of his book to this subject, and identifies the anti-malaria campaign as one of the main victims of the conflict (Snowden 2006, 158).
[26] Snowden (2006, 177) quotes a testimony referring to Sardinia in 1916, when the provincial doctors of the island openly denounced the inadequacy of state funds to conduct the distribution of quinine. The funds (63.65 pounds) would have had to increase five times to protect the anti-malaria campaign that had ceased to be a priority of government policy.
[27] Tognotti and De Franceschi (2000, 1924) included a table published by Simon (1924) about the lethality of the disease, with reference to the years 1910-1920, coherent with the data included in table 6, with partial limited exceptions.

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**Riassunto**

*La lotta contro la malaria in Sardegna fra il XIX e il XX secolo: una lezione per il presente*

Questo articolo si propone di stimare l'incidenza sanitaria della malaria in Sardegna tra gli ultimi decenni dell'Ottocento e i primi decenni del XX secolo, sottolineando i tratti distintivi della malattia nell'isola. L'analisi illustra l'eccezionale rilevanza dell'esperienza della malaria in Sardegna, dovuta all'altissimo rischio di morte tra i bambini causato dalle caratteristiche epidemiologiche e stagionali della malattia.

Il lavoro si prefigge, inoltre, di analizzare l'efficacia delle campagne di distribuzione del chinino, che permisero una graduale riduzione della mortalità, senza sconfiggere definitivamente la malattia. Il parziale fallimento di tali campagne fu dovuto principalmente all'estrema povertà della popolazione, alla sua scarsa alfabetizzazione e alla scarsità di infrastrutture sanitarie nelle aree più rurali e remote dell'isola. L'articolo fornisce un'analisi il più possibile completa, in base alla documentazione disponibile, dell'impatto demografico della malaria nella transizione sanitaria sarda ed offre, al tempo stesso, una lezione per le attuali sfide nei paesi più poveri, dimostrando che per sconfiggere la malattia è essenziale combattere le sue determinanti sociali.

**Summary**

*The fight against malaria in Sardinia at the turn of the 20th Century: a lesson for the present*

This article seeks to estimate the health burden of malaria in Sardinia between the last decades of the 19th Century and the first decades of the 20th Century, emphasizing the distinctive features of the disease in the island. The analysis illustrates the exceptional significance of malaria experience in Sardinia, due to the extremely high death risks among children caused by the epidemiological and seasonal characteristics of the disease.

The authors also aim to analyse the effectiveness of the quinine campaign, which allowed a gradual reduction of mortality, without definitively defeating the disease. The partial failure of the health campaign was mainly due to the extreme poverty of the population, its low literacy, and the scarcity of health-infrastructures in the more rural and remote areas of the island.

The article provides an analysis, as complete as possible based on the available documentation, of the demographic impact of malaria in the Sardinian health transition and offers, at the same time, a lesson for the current challenges in the poorest countries, showing that to defeat the disease it is essential to combat its social determinants.

*Parole chiave*

Cause di morte; Malaria; Mortalità; Sardegna.

*Keywords*

Causes of death; Malaria; Mortality; Sardinia.