Health & Research Journal

Vol 11, No 1 (2025)

Volume 11 Issue 1 January - March 2025

The impact of the economic crisis on mortality due to infectious diseases in Greece: An analysis of secondary data

Georgia Kourlaba, Christos Triantafyllou, Dimitrios Filippou, Vasiliki Danai Dafnomili, Giorgos Gounelas, Pavlos Myrianthefs

doi: 10.12681/healthresj.36398

HEALTH AND RESEARCH JOURNAL
E-ISSN:2459-3192

(2025), Volume 11, Issue 1

RESEARCH ARTICLE

THE IMPACT OF THE ECONOMIC CRISIS ON MORTALITY DUE TO INFECTIOUS DISEASES IN GREECE: AN ANALYSIS OF SECONDARY DATA

Georgia Kourlaba [1], Christos Triantafyllou[2], Dimitrios Filippou[3], Vasiliki Danai Dafnomili[4], Giorgos Gounelas[5], Pavlos Myrianthefs[6]

1. BSc, MSc, PhD, Assistant Professor, University of Peloponnese, School of Health Sciences, Department of Nursing, Tripoli, Greece
2. RN, MSCE, ECONCARE LP, Athens, Greece
3. MD, PhD, Assistant Professor, Department of Anatomy, School of Medicine, Faculty of Health Sciences, National and Kapodistrian University of Athens, Athens, Greece
4. Medical Student, Medical School University of Patras, Patras, Greece
5. BSc, MSc, ECONCARE LP, Athens, Greece
6. MD, PhD, Professor, National and Kapodistrian University of Athens, School of Health Sciences, Department of Nursing, Athens, Greece

Abstract

Background: The economic crisis and the implementation of austere measures in Greece and other nations prompted inquiries regarding the potential impact of financial crises on the decreasing trajectory of infectious diseases. The primary aim of this study was to explore the trends of infectious diseases mortality rates in Greece from 2000 to 2019 as well as the association between infectious diseases mortality rates and socio-economic determinants.

Method and Material: An analysis of secondary data from the World Health Organization (WHO), Organization for Economic Co-operation and Development (OECD), Eurostat, and Hellenic Statistical Authority (ELSTAT) was conducted. Data on standardized death rates (SDR) (overall, by age and sex, and for administrative regions), total health spending (in US dollars per capita and as a percentage of gross domestic product (GDP)), total GDP in euros (2022 value) per capita, unemployment, long-term unemployment, and very long-term unemployment were extracted. Pearson's or Spearman's who was used to evaluate the association between quantitative variables.

Results: From 2011, the cut-off point between the "pre-austerity" and the "exposure to austerity" period, there had been an increasing trend in both overall SDRs and age- and`-specific SDRs of infectious diseases. The overall SDRs in Greece were statistically significantly and positively correlated with unemployment and long-term unemployment (p-value<0.05).

Conclusion: It seems that the mortality of infectious diseases was affected by the economic crisis. The present findings show significance for public health, as they assist in pinpointing populations at heightened risk during crises and devising suitable measures to safeguard their well-being.

Keywords: Austerity, infectious diseases, mortality, socio-economic determinants, Greece.

Corresponding Author: Georgia Kourlaba, BSc, MSc, PhD, Assistant Professor, University of Peloponnese, School of Health Science, Department of Nursing PC22100 Tripoli/GREECE. Email: g.kourlaba@uop.gr

Cite as: Kourlaba, G., Triantafyllou, C., Filippou, D., Dafnomili, V., Gounelas, G., Myrianthefs, p. The Impact of the economic crisis on mortality due to infectious diseases in Greece: An Analysis of secondary data. (2025). Health and Research Journal,11(1),7-21. https://ejournals.epublishing.ekt.gr/index.php/HealthResJ

INTRODUCTION

Following the onset of the global financial crisis in 2008, Greece has undergone one of the most significant economic downturns in its contemporary history.[1] This crisis has had a direct impact on the Greek healthcare system, which was already grappling with fiscal challenges and structural issues prior to the economic collapse.[2] Numerous health reforms, such as decreasing pharmaceutical expenditures and restructuring social health insurance funds, have been proposed for over a decade.[3] However, these reforms were not implemented due to a lack of political determination and opposition from major stakeholders. When these measures were eventually enacted, the Greek economy was already in a state of significant decline. Moreover, the reforms primarily emphasized horizontal cost-cutting measures, targeting immediate impacts without considering long-term consequences on equity of access and quality of care [1]. A study disclosed that the challenging economic circumstances significantly augmented unmet healthcare needs in Greece.[4]

In 2011, public health expenditure witnessed a decline of 16.7% compared to the previous year, culminating in a cumulative decrease of 44.6% in nominal terms by the conclusion of 2014.[5] Concurrently, public funding allocations for hospitals experienced reductions of 23.3% in 2011 and 43.8% by 2014[5] Furthermore, during the period from 2009 to 2014, per capita Gross Domestic Product (GDP) contracted by 23.6%, the unemployment rate escalated from 9.5% to 27.5%, and the average disposable household income experienced a 24.3% reduction.[6] This resulted in a diminished capacity for individuals to make out-of-pocket healthcare payments.

Over recent decades, global fatalities from infectious diseases have diminished.[7] However, the 2008 financial crisis and subsequent austerity measures in Greece and various European nations have prompted concerns about the potential impacts of this decreasing trend.[8] The resurgence of these questions followed the worldwide economic downturn induced by the COVID-19 pandemic. The austerity measures, which influenced public health, healthcare system efficiency, and pharmaceutical provisions, [9,10] raised apprehensions regarding their potential effects on managing infectious diseases.[11,12] In Greece, the health consequences of the economic crisis became more evident after 2010, [13,14] as some conditions experienced increased mortality rates while others maintained a declining pattern.[1] Numerous studies propose that financial crises may escalate the spread of communicable diseases, [15,16] impact medication therapy and antimicrobial resistance, [4,17] or result in vaccination negligence.[18] Conversely, other studies indicate that crises may cause increased mortality rates in specific demographics, such as children, [18] the unemployed, [15] migrants, [16] or intravenous drug users.[19,20] Concentrating on the implications for mortality rates in the general population, research from multiple European nations yielded inconsistent results. Some studies discovered an elevation in infectious disease-related mortality during the crisis, [8,17,21] whereas others noted a decrease [10] or no significant impact.[22]

According to the international literature, two studies have been conducted in Greece to investigate whether the economic crisis affected the trend of infectious diseases mortality rates.[1,8] However, none of the studies correlated total health spending and very-long-term unemployment rates with infectious diseases mortality rates, and the most recent data they used concerning infectious diseases mortality rates was from 2016. Thus, the primary objective of this study was to explore the trends of infectious diseases mortality rates for Greece from 2000 to 2019 as well as the association between infectious disease mortality rates and socio-economic determinants.

The secondary aim of the study was to assess the trends of infectious disease mortality rates for the European Union (EU) countries of the South Mediterranean Region (SMR) from 2000 to 2019.

METHODOLOGY

Study design

An analysis of secondary data from the World Health Organization (WHO), Organization for Economic Co-operation and Development (OECD), Eurostat, and Hellenic Statistical Authority (ELSTAT) was conducted. Data was extracted from all databases on February 1st, 2023.

Data sources

Data regarding the standardized death rates (SDR) (overall, per

age and sex) for Greece and the EU countries of the SMR (Bulgaria, Croatia, Cyprus, France, Italy, Malta, Spain, and Portugal) were obtained from the European WHO Health Information Gateway.[23] SDRs for Greece by administrative regions, classified according to the Nomenclature of Territorial Units for Statistics 2 (NUTS 2; 13 administrative regions), were extracted from Eurostat.[24] It should be noted that data for 2011 and 2012 were not available for all administrative regions, while data for 2013 and 2014 were only available for the Attica, Crete, Northern Aegean, and Southern Aegean administrative regions. [24]

Data regarding total health spending (in US dollars per capita and as a share of gross domestic product (GDP)) for Greece and EU countries of the SMR were extracted from the OECD database.[25] Data on total GDP in EUROS (2022 value) per capita overall and by NUTS2 for Greece were obtained from ELSTAT. [26]

Data on unemployment (annual data; age class: from 15 to 74 years; unit of measure: per thousand persons), long-term unemployment (over 12 months unemployed; annual data; age class: from 15 to 74 years; unit of measure: per thousand persons), and very long-term unemployment (over 24 months unemployed; annual data; age class: from 15 to 74 years; unit of measure: per thousand persons) rates for Greece were extracted from Eurostat.[27]

Definitions

Standardized death rate (SDR): SDR is the age-standardized death rate calculated using the direct method, i.e. represents what the crude rate would have been if the population had the same age distribution as the standard European population. It contains the following ICD-10 codes for infectious and parasitic diseases: A00-A99 and B00-B99.[28]

Health spending: Health spending measures the final consumption of health care goods and services (i.e. current health expenditure), including personal health care (curative care, rehabilitative care, long-term care, ancillary services, and medical goods) and collective services (prevention and public health services as well as health administration), but excluding spending on investments. Health care is financed through a mix of financing arrangements, including government spending and compulsory health insurance ("Government/compulsory") as well as voluntary health insurance and private funds such as households' out-of-pocket payments, Non-Governmental Organizations, and private corporations ("Voluntary"). This indicator is presented as a total and by type of financing ("Government/compulsory", "Voluntary", "Out-of-pocket") and is measured as a share of GDP, as a share of total health spending, and in USD per capita.[29]

Gross domestic product (GDP): GDP is the standard measure of the value added created through the production of goods and services in a country during a certain period. As such, it also measures the income earned from that production or the total amount spent on final goods and services (fewer imports).**30**

Determination of "pre-austerity" and "exposure to austerity" period

Although the economic crisis began in 2008, major health budget cuts and other austerity measures in healthcare were implemented in Greece in 2011. The effects of the crisis on GDP and unemployment gradually manifested since 2009, but a more significant impact has been evident since 2011. As a result, 2011 was designated as the cut-off point between the "pre-austerity" period (2000-2010) and the "exposure to austerity" period (2011-2019). The latter encompasses both the significant impact on socio-economic conditions and substantial cuts in the health budget.[8]

Data analysis

Quantitative variables' normality was assessed using the Shapiro-Wilk criterion and graphically using the histograms and Q-Q plots. Means and Standard Deviations (SD) for both the "pre-austerity" (2000-2010) and the "exposure to austerity" (2011-2019) periods were calculated for quantitative variables. The two-sample t-test or Mann-Whitney U test were used to assess the association between quantitative variables and qualitative variables with two categories. Pearson's r or Spearman's rho was used to evaluate the association between quantitative variables. The following categories of Pearson's and Spearman's whose values were used for interpretation: 0.00–0.19, very weak correlation; 0.20–0.39, weak correlation; 0.40–0.69, moderate

correlation; 0.70–0.89, strong correlation; and 0.90–1.00, very strong correlation. A nominal significance level of p-value=0.05 was set for all statistical analyses. The statistical software SPSS version 28.0 was used for the statistical analyses.

Role of funding sources

This research did not receive any specific donation from the public, commercial, or not-for-profit funding agencies.

RESULTS

Standardized death rates (SDRs) of infectious diseases per 100,000 population for Greece, overall and per administrative region

Table 1 presents the SDRs of infectious diseases per 100,000 population, overall and per age and sex, from 2000 to 2019. A comparison of the mean age- and sex-specific SDRs during the "exposure to austerity" period (2011-2019) in Greece is shown in **Table S1**. Starting from 2011, which marks the cut-off point between the "pre-austerity" period and the "exposure to austerity" period, there has been an increasing trend in both overall SDRs and age- and sex-specific SDRs. Regarding overall SDRs, a statistically significant (p-value=0.005) higher mean SDR was observed during the "exposure to austerity" period (mean=12..29 per 100,000 population) compared to the "pre-austerity" period (mean=4.98 per 100,000 population) (Table S2).

During the "exposure to austerity" period, sex-specific SDRs revealed that males had a statistically significantly (p-value=0.047) higher mean SDR (12.86 per 100,000 population) than females (11.60 per 100,000 population).

In relation to age-specific SDRs, a statistically significant (p-value <0.001) higher mean SDR was observed in the age group of 65 and older (92.30 per 100,000 population) compared to the age group of 0-64 (2.40 per 100,000 population).

Furthermore, males in the age group of 0-64 demonstrated a statistically significant (p-value <0.001) higher mean SDR (3.43 per 100,000 population) compared to females in the same age group (1.44 per 100,000 population) during the "exposure to austerity" period.

SDRs of infectious diseases per administrative region in Greece from 2000 until 2017 are presented in **Figure S1**. From 2013 onwards, SDRs for administrative regions exhibited an increasing trend. The highest values of SDRs were observed in 2017, with the Ionian Islands reaching 43.90 per 100,000 population and Crete at 41.81 per 100,000 population.

Descriptive Statistics of socio-economic determinants for Greece

Descriptive statistics of socio-economic determinants for Greece from 2000 until 2019 are presented in **Table 2**. During the "exposure to austerity" period, there was an observed increase in the mean value of unemployment (489.82 versus 1,085 unemployed per thousand persons), long-term unemployment (245.82 versus 736.11 unemployed per thousand persons), and very long-term unemployment (137 versus 484.11 unemployed per thousand persons) indicators compared to the "pre-austerity" period.

Correlations between the overall standardized death rates (SDRs) of infectious diseases for Greece and socio-economic determinants

Correlations between the overall standardized death rates (SDRs) of infectious diseases for Greece and the socio-economic determinants impacted by the economic crisis are presented in **Table 3**. It was found that overall SDRs in Greece were statistically significantly and positively correlated with unemployment (Spearman's Rho=0.460; weak correlation; p-value <0.05) and long-term unemployment (Spearman's Rho=0.465; weak correlation; p-value <0.05). This indicates that when unemployment and long-term unemployment increase, SDR also increases.

Overall standardized death rates (SDRs) of infectious diseases per 100,000 population for Greece and the European Union countries of the South Mediterranean Region

SDRs of infectious diseases per 100,000 population for Greece and the EU countries of the SMR from 2000 to 2019 are presented in **Table 4**. A comparison of the mean overall SDRs between the "pre-austerity" period (2000-2010) and the "exposure to austerity" period (2011-2019) for Greece and the EU countries of the SMR is presented in Table S2.

It is noteworthy that differences were observed when exploring

the trends in SDRs of infectious diseases among the EU countries of the SMR. Specifically, Greece, Cyprus, and Italy exhibited statistically significant (p-values: 0.005, <0.001, <0.001, respectively) higher mean SDR during the "exposure to austerity" period (12.29, 10.37, 10.14 per 100,000 population, respectively) compared to the "pre-austerity" period (4.98, 6.07, 7.23 per 100,000 population, respectively).

Statistically significant lower SDRs were observed in Bulgaria (5.99 per 100,000 population), Croatia (5.33 per 100,000 population), France (9.07 per 100,000 population), Spain (7.76 per 100,000 population), and Portugal (12.18 per 100,000 population) during the "exposure to austerity" period compared to the "pre-austerity" period (7.30, 7.36, 10.84, 11.44, 16.34 per 100,000 population, respectively), with p-values of 0.001, 0.037, 0.009, <0.001, and 0.006, respectively.

Correlations between the overall standardized death rates (SDRs) of infectious diseases for Greece and the European Union countries of the South Mediterranean Region and their respective health spending

Significant negative correlation between the overall SDRs and health spending (in USD per capita) was evident in Bulgaria (Pearson's r=-0.508; weak correlation; p-value <0.05), France (Pearson's r=-0.671; weak correlation; p-value <0.05), and Spain (Pearson's r=-0.876; moderate correlation; p-value <0.05) (Table 4). This indicates that when health spending increases, SDR decreases. However, a significant positive correlation was found in Italy (Pearson's r=0.706; moderate correlation; p-value <0.05). This means that when health spending increases, SDR also increases (Table 5).

DISCUSSION

The primary objective of this study was to explore the association between infectious disease mortality rates and socio-economic determinants that were impacted by the economic crisis in Greece, as well as to examine the trends of infectious disease mortality rates for Greece from 2000 to 2019. The secondary aim of the study was to the trends of infectious disease mortality rates for the EU countries of the SMR from 2000 to 2019. To the best of our knowledge, this is the first study to correlate total health spending and very-long-term unemployment rates with infectious disease mortality rates for Greece, and the first that utilizes data on infectious disease mortality rates from 2000 to 2019.

Our study revealed several important findings. Firstly, a higher mean SDR of infectious diseases was observed during the "exposure to austerity" period compared to the "pre-austerity" period in Greece. Additionally, males had higher mean SDR than females. A significant result was that a higher mean SDR of infectious diseases was observed in the age group of 65 and older compared to the age group of 0-64. Another noteworthy finding was that the increase in unemployment and long-term unemployment was associated with higher overall SDRs in Greece. Lastly, we found that in Bulgaria, France, and Spain, an increase in health spending was associated with lower SDRs—a phenomenon that did not occur in Italy.

As previously mentioned, a very interesting finding of our study was that a higher mean SDR of infectious diseases was observed during the "exposure to austerity" period compared to the "pre-austerity" period in Greece. This result is similar to that of two previous studies.[8,31] Specifically, a Greek study conducted by Zilidis et al. [8] found that, when comparing the austerity-exposed period of 2011-2016 to the non-exposed period of 2005-2010, the overall SDR of infectious diseases recorded a significant increase of 5.0% (95% Confidence Interval (CI): 2.4%-7.7%). In another study published in 2018, Karanikolos et al. found that increases in deaths from infectious diseases before and after the crisis played a substantial part in reversals observed in Estonia, Slovenia, and Greece.[31] However, our finding contradicts this of a previous study.[10] In a 2015 study by Tapia-Granados and Rodriguez,[10] which aimed to investigate (a) whether there was a health crisis in Greece and (b) if the evolution of health indicators in Greece in recent years had been worse than in Finland and Iceland, as claimed, the researchers found that mortality caused by infectious and parasitic diseases declined after 2007 in all three countries and the change in trend was significant in Greece (p-value = 0.032) and Iceland (p-value = 0.044). The divergence in findings could be attributed to the fact that Tapia-Granados and Rodriguez's study incorporated data on infectious diseases SDRs up to 2011[10], whereas our research included data

on SDRs through 2019. It is important to remember that austerity measures within the healthcare sector were introduced in Greece in 2011.[8]

Moreover, our study found that males had a higher mean SDR of infectious diseases than females. This is consistent with the findings of a previous study. [21] Specifically, in a Polish study published in 2017, [21] which aimed to evaluate mortality due to infectious diseases in Poland from 1999 to 2012 and analyze the standard expected years of life lost due to those diseases, it was found that in 2012, the SDR of infectious diseases for males was 7.76 per 100,000 and 4.05 per 100,000 for females.

Furthermore, one more interesting finding was that a higher mean SDR of infectious diseases was observed in the age group of 65 and older compared to the age group of 0-64. This result is similar to that of two previous studies.[1,8] Zilidis et al. [8] found in their study that SDRs of infectious diseases exhibited a significant increase in age over 75 years (p-value<0.001), while the changes in all other age groups were found not significant. In another study published in 2016, [1] Laliotis et al. found that older age groups experienced more negative changes in overall mortality compared to the younger population. Numerous possible reasons exist for this pattern, such as the significant decrease in pensions for individuals over 65 years of age, or a reduction in healthcare facilities and resources, encompassing both preventive and therapeutic aspects, which primarily affect the most vulnerable population, such as the elderly.[32]

Additionally, in our study, we found that the increase in unemployment and long-term unemployment was associated with higher overall SDRs in Greece. This result is in line with that of two previous studies.[8,15] Zilidis et al. [8] found a positive association between the overall mortality rate of infectious diseases with unemployment and long-term unemployment. In a systematic review published in 2011, which aimed to examine changes in infectious disease burden subsequent to periods of crisis, statistically significant associations were found between the rise in unemployment and increases in mortality and morbidity from communicable diseases. [15] While the causal mechanisms remain somewhat unclear, it has been suggested that they may be associated with increased exposure of the unemployed to conditions that heighten the risk of transmission, as well as reduced affordability, leading to a loss of health benefits.[15,33,34] This, in turn, results in limited access to healthcare for both the unemployed and their families, restricting their ability to receive appropriate treatment.[15]

Finally, one more interesting finding was that in Bulgaria, France, and Spain, an increase in health spending was associated with lower SDRs of infectious diseases. This result is similar to that of a previous study.[35] In a Brazilian study published in 2021, [35] which aimed to explore the discontinuity in the allocation of the main federal grant to Brazilian municipalities to identify the local effects of health spending and the spillovers into bordering jurisdictions, it was found that a 1% increase in health spending reduces hospitalization for respiratory infectious diseases by 1 to 3%. This reduction leads to a decrease in the mortality rate due to infectious diseases.[35] However, in Italy, an increase in health spending was associated with higher SDRs. This may be due to the fact that Italy has the oldest population in Europe, with approximately 23% of residents being 65 or older, and Italy's median age is 46.8, compared to a global value of 30.3 years.[36] Older individuals are more susceptible to severe complications of infectious diseases, such as COVID-19, leading to higher death rates.[37]

This study has both strengths and limitations. The main strength of this study, as previously mentioned, is that this is the first study to correlate total health spending and very-long-term unemployment rates with infectious disease mortality rates for Greece and the first that utilizes data on infectious disease mortality rates from 2000 to 2019.

Some limitations should be acknowledged. The main limitation of this study is the use of secondary data, which entails two potential drawbacks: (1) there is a lack of control over data quality since the data were collected by someone else, making it difficult to ascertain its accuracy, reliability, or validity, and (2) the data could contain biases introduced by the original data collectors, which may affect the reliability of our research findings.[38] Another important limitation is that the underlying processes leading to the findings in our study could not be definitively determined. We provide potential explanations for certain trends, drawing from prior evidence; however, we cannot pinpoint specific causes, and, as a result, causal assertions should not be

made. [1,8,21,39]

CONCLUSIONS

To summarize, this research reveals that since 2011, which marks the division between the "pre-austerity" era and the "austerity exposure" phase, a rising trend has been observed in both the total SDRs and age- and sex-specific SDRs for infectious diseases. The growth in unemployment and long-term unemployment has been linked to elevated overall SDRs in Greece. It is unclear how the impact is caused, and further research is needed.

The outcomes of this research hold significance for public health, as they assist in pinpointing populations at heightened risk during crises and devising suitable measures to safeguard their well-being. Unemployed individuals and their families are more vulnerable and require targeted programs and initiatives for protection. This necessity becomes even more crucial when unemployment leads to the loss of health insurance benefits, consequently diminishing healthcare accessibility.

In future studies, a more in-depth examination of time-delay effects and the incorporation of suitable control groups is essential.

Declarations of interests

All authors declare no conflict of interest.

Acknowledgments

Not applicable.

Data Sharing

This study is a secondary analysis of publicly available data from the World Health Organization (WHO), Organization for Economic Co-operation and Development (OECD), Eurostat, and Hellenic Statistical Authority (ELSTAT). Data was extracted from all databases on February 1st, 2023

REFERENCES

1. Laliotis I, Ioannidis JPA, Stavropoulou C. Total and cause-specific mortality before and after the onset of the Greek economic crisis: an interrupted time-series analysis. Lancet Public Health 2016; 1: e56–65.
2. Mossialos E, Allin S, Davaki K. Analysing the Greek health system: a tale of fragmentation and inertia. Health Econ 2005; 14: S151-168.
3. Economou C, Kaitelidou D, Kentikelenis A, Maresso A, Sissouras A. The impact of the crisis on the health system and health in Greece. In: Economic crisis, health systems and health in Europe: Country experience [Internet]. European Observatory on Health Systems and Policies, 2015.
4. Zavras D, Zavras AI, Kyriopoulos I-I, Kyriopoulos J. Economic crisis, austerity and unmet healthcare needs: the case of Greece. BMC Health Serv Res 2016; 16: 309.
5. Zilidis C, Stuckler D, McKee M. Use of amenable mortality indicators to evaluate the impact of financial crisis on health system performance in Greece. Eur J Public Health 2020; 30: 861–6.
6. Zilidis C, Hadjichristodoulou C. Economic Crisis Impact and Social Determinants of Perinatal Outcomes and Infant Mortality in Greece. Int J Environ Res Public Health 2020; 17: 6606.
7. Institute for Health Metrics and Evaluation (IHME). Findings from the global burden of disease study 2017. Institute for Health Metrics and Evaluation 2018.
8. Zilidis C, Papagiannis D, Kyriakopoulou Z. Did Economic Crisis Affect Mortality Due to Infectious Diseases? Trends of Infectious Diseases Mortality in Greece Before and After Economic Crisis. Cureus 2021; 13: e13621.
9. Bacigalupe A, Shahidi FV, Muntaner C, Martín U, Borrell C. Why is There so Much Controversy Regarding the Population Health Impact of the Great Recession? Reflections on Three Case Studies. Int J Health Serv 2016; 46: 5–35.
10. Tapia Granados JA, Rodriguez JM. Health, economic crisis, and austerity: A comparison of Greece, Finland and Iceland. Health Policy 2015; 119: 941–53.
11. Rechel B, Suhrcke M, Tsolova S, et al. Economic crisis and communicable disease control in Europe: a scoping study among national experts. Health Policy 2011; 103: 168–75.

12. McDaid D, Quaglio G, Correia de Campos A, et al. Health protection in times of economic crisis: challenges and opportunities for Europe. J Public Health Policy 2013; 34: 489–501.
13. Parmar D, Stavropoulou C, Ioannidis JPA. Health outcomes during the 2008 financial crisis in Europe: systematic literature review. BMJ 2016; 354: i4588.
14. Simou E, Koutsogeorgou E. Effects of the economic crisis on health and healthcare in Greece in the literature from 2009 to 2013: a systematic review. Health Policy 2014; 115: 111–9.
15. Suhrcke M, Stuckler D, Suk JE, et al. The impact of economic crises on communicable disease transmission and control: a systematic review of the evidence. PLoS One 2011; 6: e20724.
16. Kentikelenis A, Karanikolos M, Williams G, et al. How do economic crises affect migrants' risk of infectious disease? A systematic-narrative review. Eur J Public Health 2015; 25: 937–44.
17. Karanikolos M, Kentikelenis A. Health inequalities after austerity in Greece. Int J Equity Health 2016; 15: 83.
18. Scognamiglio P, Girardi E, Fusco M, et al. Lack of implementation of Hepatitis B Virus (HBV) vaccination policy in household contacts of HBV carriers in Italy. BMC Infect Dis 2009; 9: 86.
19. Gyarmathy VA, Neaigus A, Ujhelyi E. Vulnerability to drug-related infections and co-infections among injecting drug users in Budapest, Hungary. Eur J Public Health 2009; 19: 260–5.
20. Rafiq SM, Banik GR, Khan S, Rashid H, Khandaker G. Current Burden of Hepatitis C Virus Infection Among Injecting Drug Users: A Mini Systematic Review of Prevalence Studies. Infect Disord Drug Targets 2014; 14: 93–100.
21. Bryla M, Dziankowska-Zaborszczyk E, Bryla P, Pikala M, Maniecka-Bryla I. Years of life lost due to infectious diseases in Poland. PLoS One 2017; 12: e0174391.
22. Toffolutti V, Suhrcke M. Does austerity really kill? Economics & Human Biology 2019; 33: 211–23.
23. WHO European Region. European Health Information Gateway. https://gateway.euro.who.int/en/datasets/ (accessed Feb 1, 2023).
24. Eurostat. Causes of death - standardised death rate by NUTS 2 region of residence, 3 year average. https://ec.europa.eu/eurostat/data-browser/view/HLTH_CD_YSDR2/default/table?lang=en&category=hlth.hlth_cdeath.hlth_cd_gmor (accessed Feb 1, 2023).
25. OECD. OECD database. theOECD. http://data.oecd.org (accessed Feb 1, 2023).
26. Hellenic Statistical Authority (ELSTAT). Gross Domestic Product. https://www.statistics.gr/en/statistics/-/publication/SEL15/- (accessed Feb 1, 2023).
27. Eurostat. Employment and unemployment (Labour force survey). https://ec.europa.eu/eurostat/data-browser/explore/all/popul?lang=en&subtheme=labour.employ&display=list&sort=category&extractionId=UNE_LTU_A_H__custom_4603984 (accessed Feb 1, 2023).
28. WHO European Region. SDR, infectious and parasitic diseases, all ages, per 100 000. https://gateway.euro.who.int/en/indicators/hfa_203-1820-sdr-infectious-and-parasitic-diseases-all-ages-per-100-000/ (accessed April 24, 2023).
29. OECD. Health resources - Health spending - OECD Database. theOECD. http://data.oecd.org/healthres/health-spending.htm (accessed April 24, 2023).
30. OECD. GDP and spending - Gross domestic product (GDP) - OECD Data. theOECD. http://data.oecd.org/gdp/gross-domestic-product-gdp.htm (accessed April 24, 2023).
31. Karanikolos M, Mackenbach JP, Nolte E, Stuckler D, McKee M. Amenable mortality in the EU-has the crisis changed its course? Eur J Public Health 2018; 28: 864–9.
32. Loopstra R, McKee M, Katikireddi SV, Taylor-Robinson D, Barr B, Stuckler D. Austerity and old-age mortality in

England: a longitudinal cross-local area analysis, 2007-2013. J R Soc Med 2016; 109: 109–16.

33. Axelrad H, Sabbath EL, Hawkins SS. The impact of the 2008 recession on the health of older workers: data from 13 European countries. Eur J Public Health 2017; 27: 647–52.
34. Hunter PR, Colón-González FJ, Brainard J, et al. Can economic indicators predict infectious disease spread? A cross-country panel analysis of 13 European countries. Scand J Public Health 2020; 48: 351–61.
35. Castro M, Mattos E, Patriota F. The effects of health spending on the propagation of infectious diseases. Health Econ 2021; 30: 2323–44.
36. World Economics. Italy's Median Age. World Economics. 2023. https://www.worldeconomics.com/Demographics/Median-Age/Italy.aspx (accessed April 27, 2023).
37. Minnai F, De Bellis G, Dragani TA, Colombo F. COVID-19 mortality in Italy varies by patient age, sex and pandemic wave. Sci Rep 2022; 12: 4604.
38. Wickham RJ. Secondary Analysis Research. J Adv Pract Oncol 2019; 10: 395–400.
39. Ioannidis JPA. Exposure-wide epidemiology: revisiting Bradford Hill. Stat Med 2016; 35: 1749–62.

ANNEX

TABLE 1. Standardized death rates (SDRs) of infectious diseases per 100,000 population (overall, per age and sex), 2000-2019

Indicators	**SDR Total**	**SDR Female**	**SDR Male**	**SDR 0-64**	**SDR +65**	**SDR 0-64 Female**	**SDR 0-64 Male**	**SDR +65 Female**	**SDR +65 Male**
Year									
2000	3.72	2.95	4.53	1.68	20.17	1.01	2.36	18.61	22.12
2001	4.35	3.60	5.13	1.4	28.21	0.75	2.05	26.64	30.02
2002	5.15	4.53	5.79	1.68	33.26	1.07	2.30	32.49	34.07
2003	4.83	4.00	5.70	1.46	32.10	0.73	2.20	30.44	34.02
2004	4.31	3.51	5.19	1.49	27.13	0.88	2.12	24.74	30.01
2005	4.74	4.42	5.00	1.41	31.69	0.94	1.87	32.60	30.31
2006	4.58	4.02	5.13	1.24	31.63	0.62	1.86	31.53	31.63
2007	5.52	5.15	5.87	1.49	38.18	0.99	1.99	38.82	37.23
2008	5.91	5.18	6.65	1.50	41.58	0.71	2.32	41.36	41.73
2009	6.25	5.46	7.07	1.67	43.29	0.82	2.54	42.98	43.73
2010	5.44	4.81	6.05	1.73	35.43	0.96	2.50	35.95	34.78
2000-2010	4.98	4.33	5.65	1.52	32.97	0.86	2.19	32.38	33.60
Mean (SD)	(0.75)	(0.79)	(0.75)	(0.15)	(6.62)	(0.14)	(0.24)	(7.30)	(5.97)
2011*	4.72	4.20	5.27	1.42	31.46	0.93	1.90	30.70	32.52
2012	5.32	4.37	6.37	1.66	34.86	1.13	2.23	30.59	39.90
2013									
2014	14.16	13.02	15.25	2.86	105.59	1.65	4.15	105.01	105.08
2015	14.97	14.54	15.11	2.40	116.64	1.45	3.43	120.5	109.63
2016	15.09	14.35	15.63	2.87	114.02	1.67	4.14	116.89	108.54
2017	15.39	14.70	15.91	3.03	115.44	1.9	4.23	118.27	110.39
2018	14.08	13.80	14.09	2.45	108.17	1.47	3.52	113.53	99.62
2019	14.59	13.79	15.25	2.53	112.24	1.33	3.82	114.61	107.77
2011-2019	12.29	11.60	12.86	2.40	92.30	1.44	3.43	93.76	89.18
Mean (SD)	(4.51)	(4.54)	(4.39)	(0.58)	(36.70)	(0.31)	(0.89)	(39.22)	(32.93)

*. The cut-off points between the "pre-austerity" period (2000-2010) and the "exposure to austerity" period (2011-2019) in Greece; SD, Standard deviation

Source: WHO European Region. WHO European Health Information Gateway [23]

TABLE 2. Descriptive statistics of socio-economic determinants for Greece, 2000-2009

Indicators	**Health spend-ing****	**Health spend-ing*****	**GDP********	**Unemploy-ment^**	**Long-term unem-ployment ^**	**Very-long-term Unemployment^**
Year						
2000		.				
2001		.				
2002		.				
2003		.				
2004		.				
2005		.				
2006		.				
2007		.				
2008		.				
2009		.				
2010		.				
2000-2010	2,195.45	8.46	18,043.45	489.82	245.82	137
Mean (SD)	(410.53)	(0.66)	(3,088.33)	(64.96)	(35.31)	(19.91)
2011*		.				
2012		.				
2013		.				
2014		.				
2015		.				
2016		.				
2017		.				
2018		.				
2019		.				
2011-2019	2,203.56	8.40	16,756	1,085	736.11	484.11
Mean (SD)	(115.53)	(0.41)	(669.87)	(182.60)	(164.62)	(136.28)

Note. GDP, Gross domestic product

*. The cut-off points between the "pre-austerity" period (2000-2010) and the "exposure to austerity" period (2011-2019) in Greece; SD, Standard Deviation

****.** In USD per capita; *****.** As a share of GDP; ******.** In EUROS (2022 value) per capita; **^.** Per thousand persons

Source: Organization for Economic Co-operation and Development (OECD), Eurostat and Hellenic Statistical Authority (ELSTAT) [26,27,30]

.

TABLE 3. Correlations between the overall standardized death rates (SDRs) of infectious diseases for Greece and the socio-economic determinants that were impacted by the economic crisis

	Spearman's Rho
	SDR (Overall)
Heath spending (in USD per capita)	0.400
***Health spending (*as a share of gross domestic product (GDP)**	0.075
GDP	0.025
Unemployment	**0.460***
Long-term unemployment (over 12 months unemployed)	**0.465***
Very- long-term unemployment (over 24 months unemployed)	0.453

*. Correlation is significant at the 0.05 level (2-tailed)

TABLE 4. Overall **s**tandardized death rates (SDRs) of infectious diseases per 100,000 population for Greece and the European Union countries of the South Mediterranean Region, 2000-2019

Country	**Greece**	**Bulgaria**	**Croatia**	**Cyprus**	**France**	**Italy**	**Malta**	**Spain**	**Portugal**
Year									
	.						0		
			0						0
		0							
			0			0			
		0		0					
		0							
					.00				
2000-2010	4.98	7.30	7.36	6.07	10.84	7.23	3.33	11.44	16.34
Mean (SD)	(0.75)	(0.63)	(2.09)	(1.19)	(1.02)	(1.56)	(1.27)	(1.12)	(3.35)
*									
								0	
		0							
2017							0		
2018							-	0	
2019									

2011-2019	12.29	5.99	5.33	10.37	9.07	10.24	4.2	7.76	12.18
Mean (SD)	(4.51)	(0.89)	(1.67)	(2.13)	(0.85)	(0.84)	(0.68)	(0.89)	(1.68)

*. The cut-off points between the "pre-austerity" period (2000-2010) and the "exposure to austerity" period (2011-2019) in Greece; SD, Standard deviation

Source: WHO European Region. WHO European Health Information Gateway[23]

TABLE 5. Correlations between the overall standardized death rates (SDRs) of infectious diseases for Greece and the European Union countries of the South Mediterranean Region and their respective health spending

	Spearman's Rho
SDR (Overall)	Heath spending (in USD per capita)
G	0
Bulgaria	**-**
Croatia	0
Cyprus	0
France	**-**
Italy	**0**
Malta	-
Spain	**-**
Portugal	-

‡. Pearson's r; *. Correlation is significant at the 0.05 level (2-tailed)

Supplementary material

TABLE S1. Comparison of the mean age- and gender-specific standardized death rates (SDRs) of infectious diseases during the "exposure to austerity" period (2011-2019) in Greece

Demographics	Mean (SD) 2011-2019	p-value
Female	11.60 (4.54)	**0.047‡**
Male	12.86 (4.39)	
0-64	2.40 (0.58)	**<0.001‡**
65	92.30 (36.70)	
0-64 Female	1.44 (0.31)	**<0.001⁺**
0-64 Male	3.43 (0.89)	
65 Female	93.76 (39.22)	0.248‡
65 Male	89.18 (32.93)	

⁺ Two-sample t-test

‡ Mann-Whitney U test

TABLE S2. Comparison of the mean overall standardized death rates (SDRs) between the "pre-austerity" period (2000-2010) and the "exposure to austerity" period (2011-2019) for Greece and the European Union countries of the South Mediterranean Region

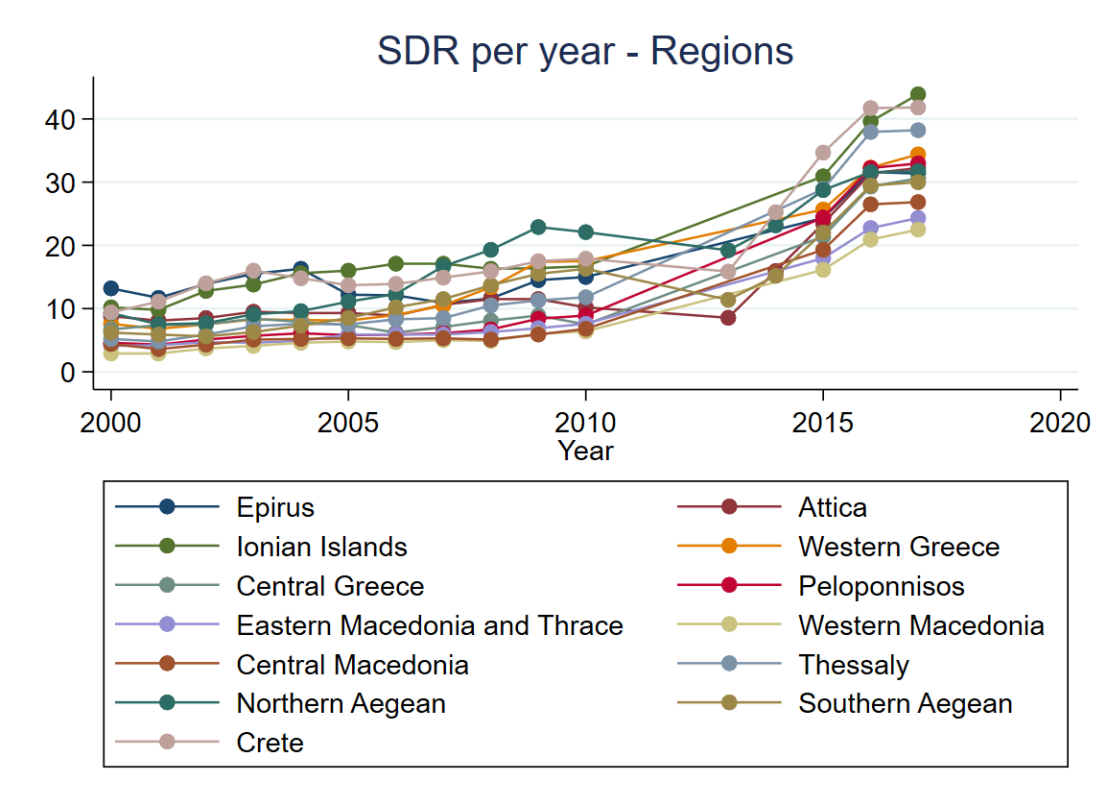
Country	Mean (SD) 2000-2010	Mean (SD) 2011-2019	p-value
Greece	4.98 (0.75)	12.29 (4.51)	**0.005‡**
Bulgaria	7.30 (0.63)	5.99 (0.89)	**0.001⁺**
Croatia	7.36 (2.09)	5.33 (1.67)	**0.037⁺**
Cyprus	6.07 (1.19)	10.37 (2.13)	**< 0.001⁺**
France	10.84 (1.02)	9.07 (0.85)	**0.009⁺**
Italy	7.23 (1.56)	10.24 (0.84)	**< 0.001‡**
Malta	3.33 (1.27)	4.2 (0.68)	0.117⁺
Spain	11.44 (1.12)	7.76 (0.89)	**< 0.001‡**
Portugal	16.34 (3.35)	12.18 (1.68)	**0.006‡**

⁺ Two-sample t-test

‡ Mann-Whitney U test

FIGURES

Figure S1. Standardized death rates (SDRs) of infectious diseases per administrative region in Greece, 2000-2017



Note. Data for 2011 and 2012 were not available for all administrative regions. Data for 2013 and 2014 were only available for the Attica, Crete, Northern Aegean, and Southern Aegean administrative regions.

Source: Eurostat *(24)*