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LONG-TERM TRENDS AND RECENT UPTURNS IN REGIONAL MORTALITY VARIATIONS IN GREECE

Vasilis S. GAVALAS
University of the Aegean, Department of Geography, Mytilene, Greece
https://geography.aegean.gr/ppl/index.php?content=0&bio=bgav
bgav@geo.aegean.gr

Abstract

Great regional variations in mortality within a country reflect unequal social and economic development and an ineffective health system. On the other hand, small mortality variations from one region to another indicate more homogeneous development and a relatively equal access to the national health system. Greece has made remarkable progress in this respect over the last 35 years. The current paper documents this progress in two ways: firstly, by inspecting regional variations in infant and in general mortality from 1981 onwards and second by associating indexes of economic and social development of each region with its level of mortality. A gradual convergence of the mortality rates across the country and a consequent de-association of the per capita income from the mortality level of an area point to a more effective welfare system over the examined period. The only ambivalent period is that of 2009-2014, where no progress is recorded in infant mortality, probably because of the cuts in public health spending, stemming from an acute economic crisis which started in 2009.

Keywords: *Standardized Mortality Rate, Infant Mortality Rate, Administrative divisions, Physicians per 100,000 population, Regional variations, Official statistics.*

1. INTRODUCTION

The current research draws on official statistics (vital statistics and population estimates) to sketch the mortality profile of modern Greece. The paper focuses on regional variations in infant and general mortality from 1981 to 2014. The research at hand comes as an addition to the existing literature on the regional dimensions of Greece's mortality, which (literature) consists of few but rigorous studies on the issue (Androulaki, 2007a; Androulaki, 2007b, Papastergiou, Rachiotis, Polyzou, Zilidis, Hadjichristodoulou, 2008; Agorastakis, 2009; Petrakos, 2009; Gavalas, 2015). These studies document that the Regions in the North and North-eastern Greece, (mainly the Region of Eastern Macedonia and Thrace) presented higher mortality than the national average even in the turn of the 21st century. On the other hand, the most privileged Regions, mortality-wise, are located on the West and South-West of Greece, namely the islands of the South Aegean and Crete.

A previous study on regional variation in mortality in Greece has pinpointed three possible risk factors for the raised mortality in certain areas, namely GDP per capita, number of physicians per 100,000 population and number of hospital beds per 100,000 population. All these three factors were proved statistically significant explanatory factors for the raised mortality in the young age-groups 0-14 years old (Papastergiou et al., 2008). Regional variations in the economic growth of Greece and especially the core-periphery imbalances

have been documented substantially by economists and geographers alike (Iconomou, 2011; Petrakos, 2009).

A question raised by the current economic situation in Greece is in what extent the economic crisis has affected mortality rates in national and regional level. It is well established that Greece was going through a period of economic development up to 2008, during which the Gross Domestic Product (GDP) of the country was increasing and the unemployment had fallen to one-digit figures (ELSTAT 2016a; ELSTAT 2016b). More specifically the per capita GDP of Greece was amounted to 21,845 euros in 2008 and the unemployment rate to 9.6%, ascending from even lower figures in previous years. Since 2009, however, the GDP of Greece is continuously decreasing, dropping to 16,181 euros per inhabitant in 2015 and the unemployment rate reached 27.5% in 2013 due to a fiscal crisis, which caused a drop in the living standards for most of the population (ELSTAT 2016a; ELSTAT 2016b). An economic setback to such an extent is unusual for a developed country and unprecedented for a member state of the European Union.

There is at least one study which claims that infant mortality rate (IMR) raised by 43% between 2008 and 2010 due to cuts in public health spending (Kentikelenis, Karanikolos, Revees, McKee, Stuckler, 2014). The current paper reassesses the existing studies in the light of more recent evidence (data up to 2014) and debates the convergence of mortality indexes over a period of 34 years. As far as the recent economic crisis is concerned, the paper at hand tries to assess the impact of this situation on infant mortality and on the mortality of the general population by deriving valid and comparable mortality indices and by correlating socio-economic variables with mortality rates.

2. METHODS

The main geographical unit of analysis is the Region, which is an administrative entity corresponding to NUTS 2 (***N****omenclature des* ***U****nités* ***T****erritoriales* ***S****tatistiques*), according to the standardization used by Eurostat for comparing administrative divisions across European Union. Greece is divided in 13 Regions. However, in the following analysis the Prefecture of Thessaloniki (which is a Regional Unit in the NUTS 3 level) is examined separately from the Region of Central Macedonia, where it belongs, because Thessaloniki, as the second biggest urban center of Greece, presents different demographic behavior from the rest of Central Macedonia. Therefore, mortality indexes for the Region of Central Macedonia have been re-calculated without the Prefecture of Thessaloniki and in that manner they are presented in the following tables and figures. For the greater Athens area no special treatment was necessary, since the Prefecture of Attica (as the greater Athens is called) coincides geographically with the Region of Attica. Figure 1 shows the 14 administrative, quasi-geographical, units for which mortality analysis has been made. A fifteenth unit, namely Mount Athos, is shown on the figures, but no analysis has been made for this area, since it constitutes a special case within the Greek territory. It is an autonomous monastic community populated by approximately 2000 men. The small population of Mount Athos and its peculiar structure (adult men only) do not allow us to derive any comparable mortality indexes for this area.

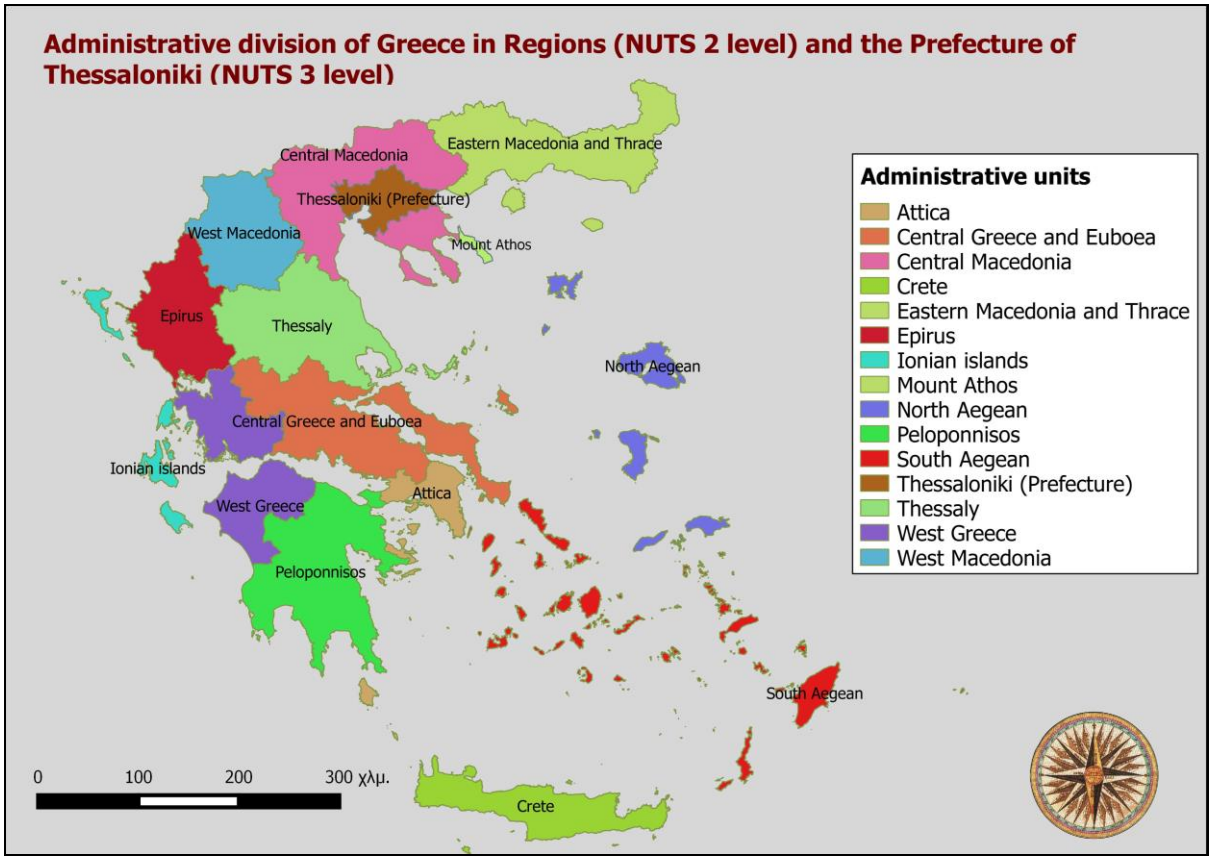

Figure 1: Geographical units of analysis.

Infant mortality indexes serve as a methodological tool to compare regional variations in mortality because the level of infant mortality reflects the socio-economic conditions that prevail in a region and it is a fair indicator of the adequacy of the health services and the social warfare. The conventional infant mortality rate (which is the one used in this study) demonstrates how many new born die in the first year of their life out of 1000 live-births (infant deaths per 1000 live-births). This rate is considered to be a basic indicator of social development, something that attests to the significance of infant mortality.

Another set of methodological tools that are employed in this study to compare the mortality level of different populations (or of the same population in different points in time) are the standardized mortality rates, or SMRs (shown in figures 7 to 10). SMRs are suitable for comparisons, because they are not affected by the age structure of the populations under study. Unlike SMRs, Crude Death Rates (CDRs) are affected by the age structure of the population and therefore one cannot compare an aged population with a young one based on CDRs, because these rates will not reflect the mortality regime of each population. The Standardized Mortality Rates used here were calculated with the method of indirect standardization (Papadakis & Tsimpos, 2004). The age-specific mortality rates of the population of Greece for each selected year (namely 1981, 1991, 2001, 2014) were applied to the age structure of the 14 geographical units examined here. The Standardized Mortality Rates (SMRs) express the mortality of each geographical unit as percentage of the average mortality level of Greece. Values lower than 100 denote smaller mortality than the national average, while values greater than 100 denote greater mortality than the national average.

The last section of this paper tries to examine the causes of any regional variations. In this end, the issue that is investigated is whether there is any relationship between the mortality level on the one hand and income, availability of hospital beds and doctors on the other hand

(availability is measured in terms of hospital beds (or doctors respectively) per 100,000 population). These bi-variate associations are quantified with the use of Pearson's correlation coefficient (Pearson's r).

3. ANALYSIS

3.1 Regional variations in Infant mortality

It is worth examining infant mortality separately from the mortality of the general population because the level of infant mortality reflects the socio-economic conditions that prevail in a country and it is a fair indicator of the adequacy of the health services and the social warfare.

Figures 2 to 6 present IMR by Region (plus the Prefecture of Thessaloniki, which is examined separately from the Region of Central Macedonia for reasons stated in the introduction).

In 1981 East Macedonia and Thrace was the Region with the highest infant mortality (around 25‰), followed by the two main urban centers of Greece, Athens (in the Region of Attica) and Thessaloniki with IMR 18‰ and 19.3‰ respectively (figure 2). North Aegean was also a Region with higher IMR than the national average. However, the infant mortality rate in the Region of North Aegean was only slightly higher than the national average (17.4‰ versus 16.9‰). The remaining Regions presented lower infant mortality than the national average, with the lowest IMRs recorded in Crete and the South Aegean (just above 10‰).

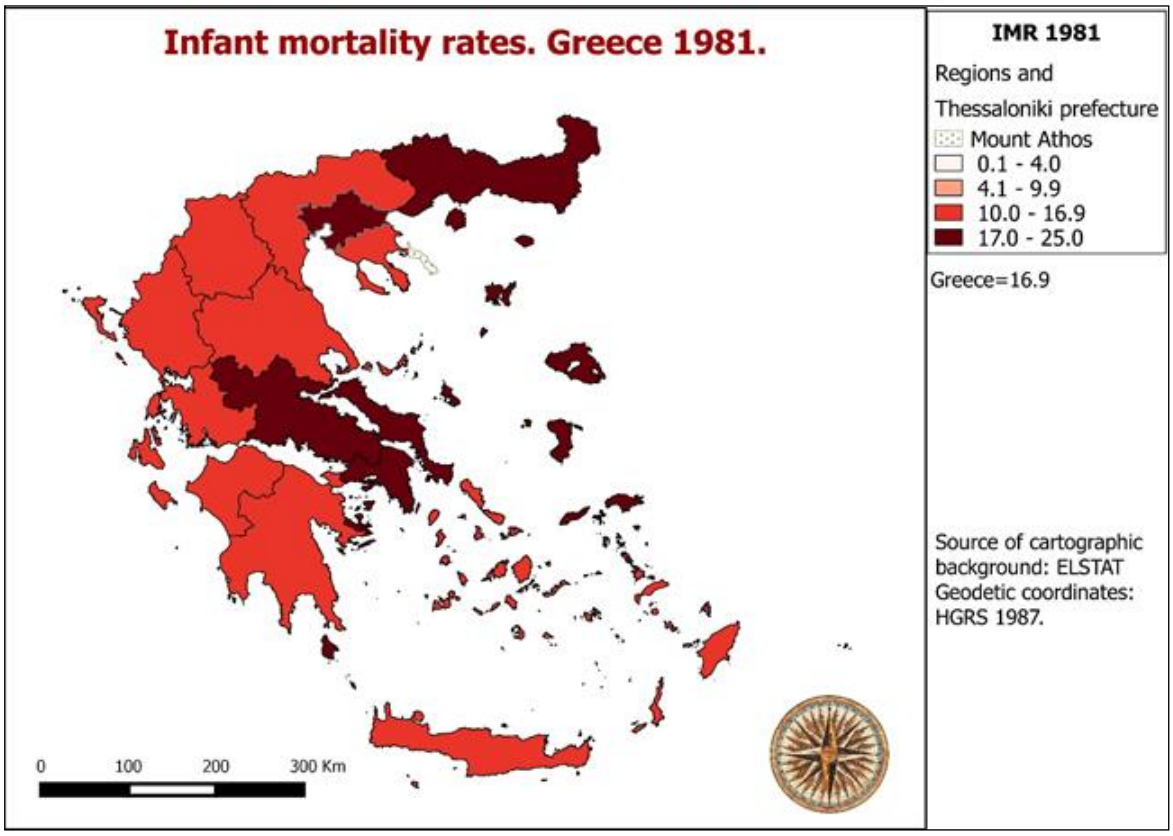

Figure 2: Infant mortality Rate (infant deaths per 1000 livebirths) in 14 administrative units (Regions and the Prefecture of Thessaloniki). Greece 1981

In 1991 infant mortality had dropped to 9‰ from 16.9‰ that was a decade ago (figure 3). The two main urban centers of Greece continued to record higher infant mortality than the national average with Thessaloniki having the highest IMR (12.7‰). West Greece was also above the national average as far as IMR was concerned. The remaining Regions presented lower infant mortality than the national average, with the lowest IMRs recorded in the South Aegean (5.3‰).

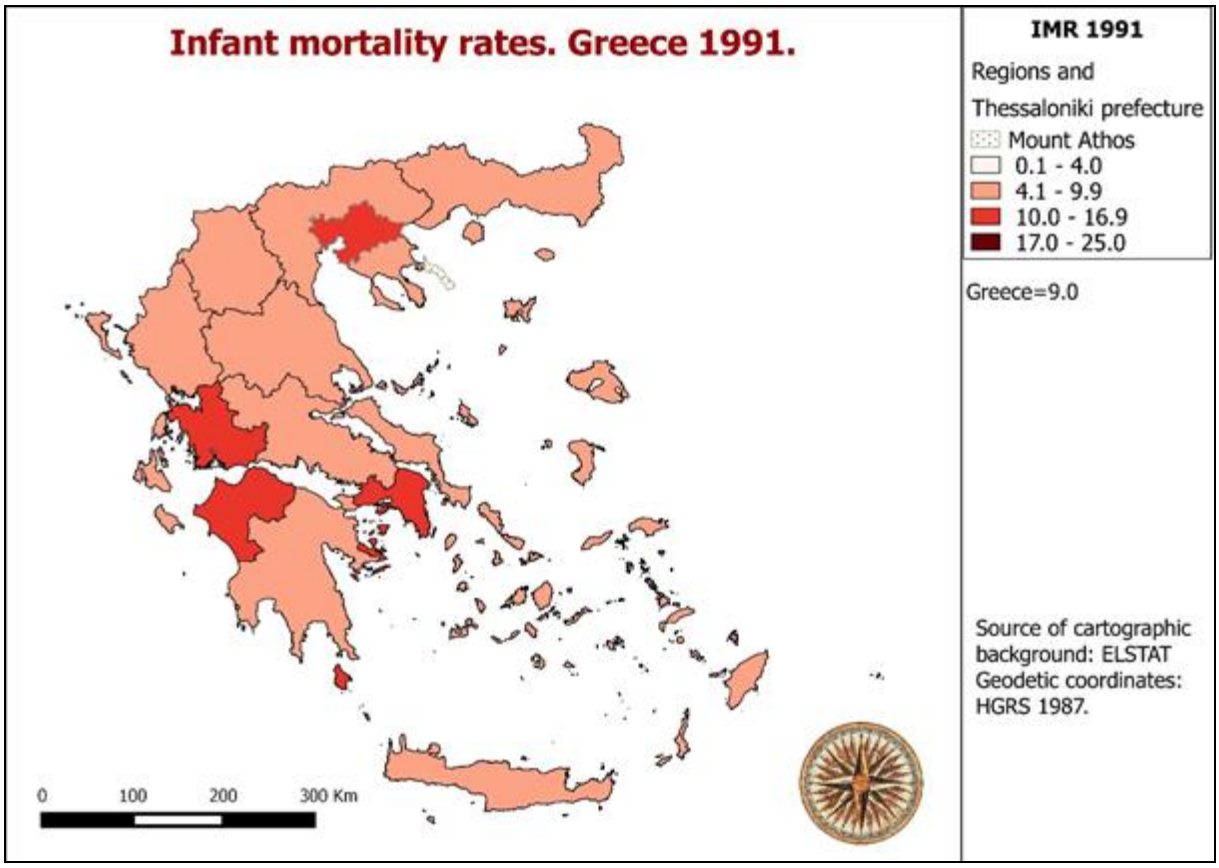

Figure 3: Infant mortality Rate (infant deaths per 1000 livebirths) in 14 administrative units (Regions and the Prefecture of Thessaloniki). Greece 1991

In 2001 regional variations in mortality had diminished even more (figure 4). The deviation from the national average (which dropped to 5.1‰) was ±1.6 units, as opposed to ±2.6 units in 1991 and ±4.1 in 1981. The two main urban centers (Athens and Thessaloniki) did not record higher infant mortality than the national average, as was the case in the previous decades (in 2001 their IMR was around 5‰). The Region with the highest IMR was West Greece (7.4‰) and there were two Regions, namely Epirus and South Aegean with IMRs less than 4‰ (2.6‰ for Epirus and 3.3‰ for South Aegean).

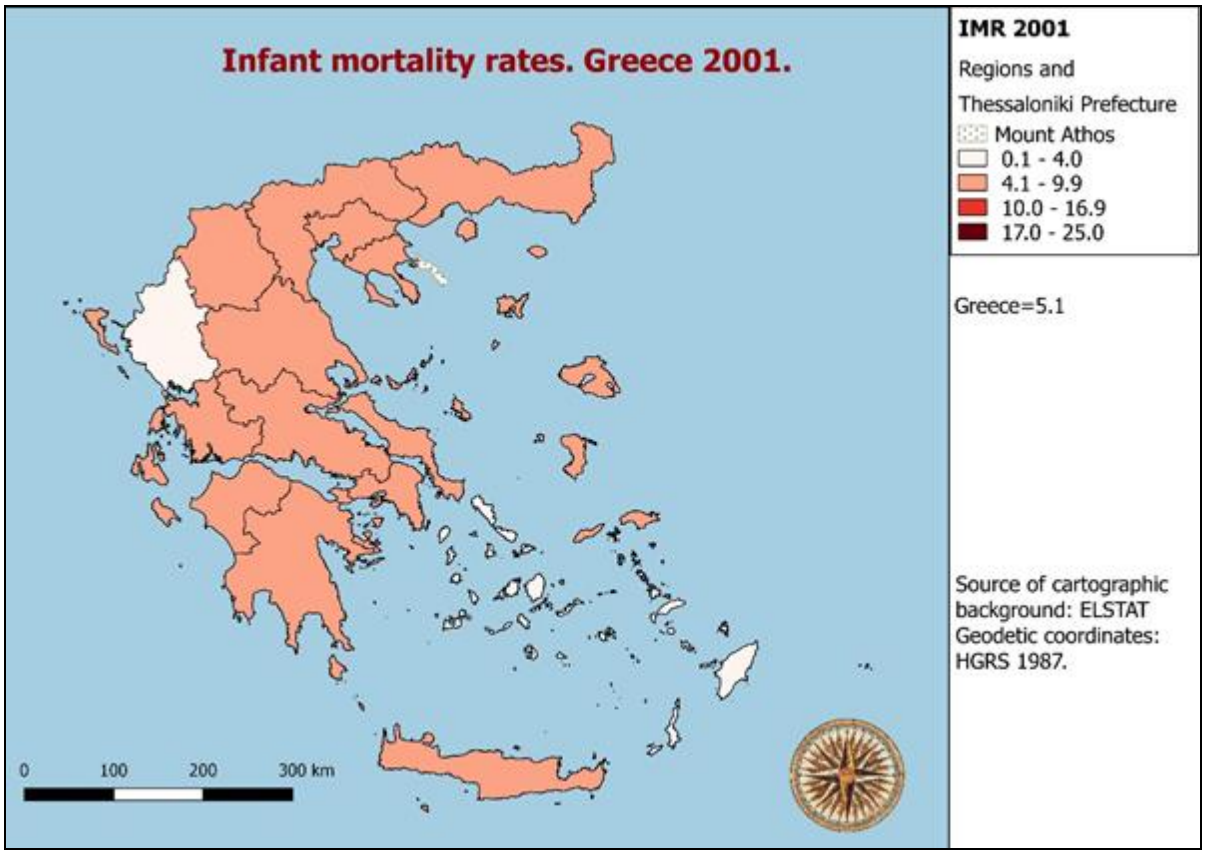

Figure 4: Infant mortality Rate (infant deaths per 1000 livebirths) in 14 administrative units (Regions and the Prefecture of Thessaloniki). Greece 2001

In the first decade of the 21st century regional variations in Greece as far as infant mortality is concerned, are negligible. Infant deaths are too few to allow a regional analysis in yearly basis. There are Regions, like the Ionian islands, West Macedonia, North and South Aegean, where infant deaths in a single year are less than 10 (and less than 5 in certain years) and any comparison should be based on time series of several years to be trustworthy. Even for greater Regions an analysis of infant mortality based on a single year is not reliable because variations from one year to another are circumstantial and due to the very small number of infant deaths. Figures 5 and 6 attempt to compare IMRs in the 14 administrative units examined here based on data concerning three consecutive years, 2009-2011 in figure 5 and 2012-2014 in figure 6. Even with aggregate data of three years, in 7 out of the 14 administrative units less than 50 infant deaths were recorded in every three-year period (2009-2011 and 2012-2014).

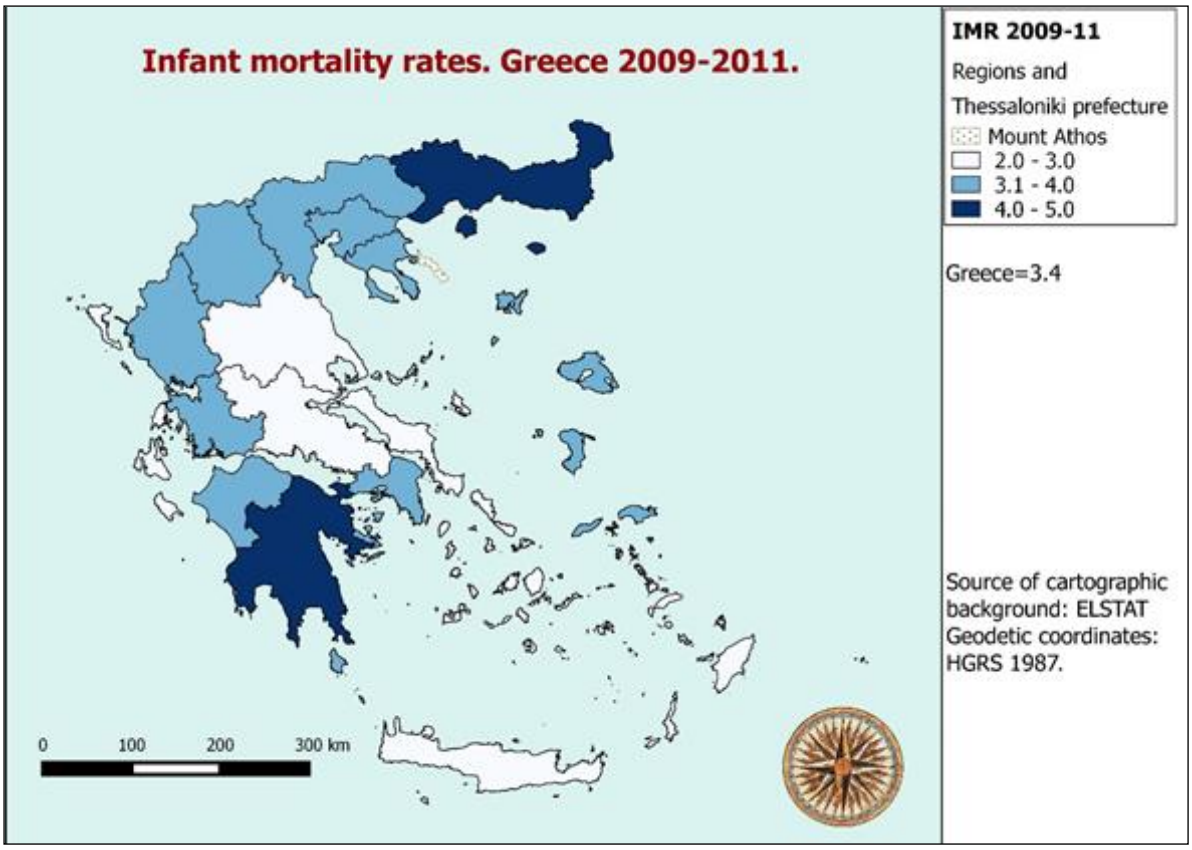

Figure 5: Infant mortality Rate (infant deaths per 1000 livebirths) in 14 administrative units (Regions and the Prefecture of Thessaloniki). Greece 2009-2011.

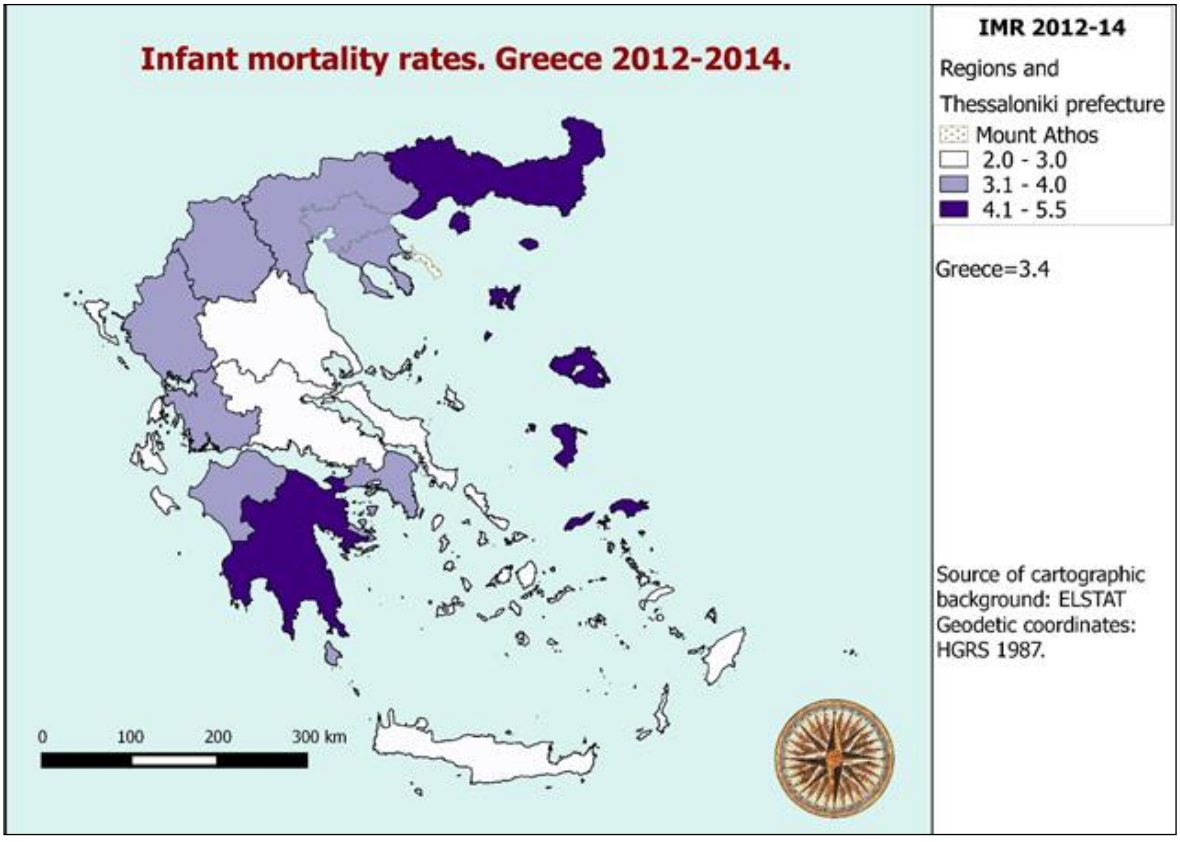

Figure 6. Infant mortality Rate (infant deaths per 1000 livebirths) in 14 administrative units (Regions and the Prefecture of Thessaloniki). Greece 2012-2014.

Table 1 presents the data series used for the construction of figures 2 to 6. The last row of table 1 shows the standard deviation of infant mortality for each year. Standard deviation can be used as an indication of variation since it is a measure of dispersion of the data around their mean. It is obvious that regional variation was continuously reducing in Greece from 1981 to 2009-11.

Table 1. Infant Mortality Rates (IMRs) and their measures of dispersion from 1981 to 2012-14

Region	**IMR 1981**	**IMR 1991**	**IMR 2001**	**IMR 2009-11**	**IMR 2012-14**
Eastern Macedonia and Thrace	24.9	9.5	6.6	4.9	5.4
Central Macedonia (without Thessaloniki)	13.0	6.6	4.8	3.6	4.1
West Macedonia	13.3	5.7	4.3	3.6	3.6
Epirus	15.5	8.7	2.6	3.1	3.4
Thessaly	11.3	6.0	4.6	2.4	2.0
Central Greece and Euboea	25.0	5.5	5.9	2.7	2.2
Ionian islands	13.9	8.1	4.2	2.7	2.2
West Greece	15.7	11.1	7.4	3.1	3.9
Peloponnesus	15.1	6.4	4.6	4.1	4.3
Attica	18.0	10.5	5.1	3.7	3.2
North Aegean	17.4	7.1	5.3	3.6	4.7
South Aegean	10.8	5.3	3.3	2.7	2.2
Crete	10.4	7.4	4.8	2.0	2.7
Thessaloniki (Prefecture)	19.3	12.7	5.2	3.6	4.1
Greece	16.9	9.0	5.1	3.4	3.4
Max	**25.0**	**12.7**	**7.4**	**4.9**	**5.4**
Min	**10.4**	**5.3**	**1.9**	**2.0**	**2.0**
St. Deviation	**4.8**	**2.7**	**1.6**	**0.7**	**1.0**

Source: Births and infant deaths provided by ELSTAT

3.2 Regional variations in mortality of the general population

It was established above that geographical variations in infant mortality in Greece were diminished in the beginning of the 21st century, at least at the level of the 14 geographical units examined here. Nevertheless, the mortality of the general population keeps fluctuating across Regions, although not to the extent it used to be in the past. The course of mortality from 1981 to 2014 is presented in figures 7 to 10 below.

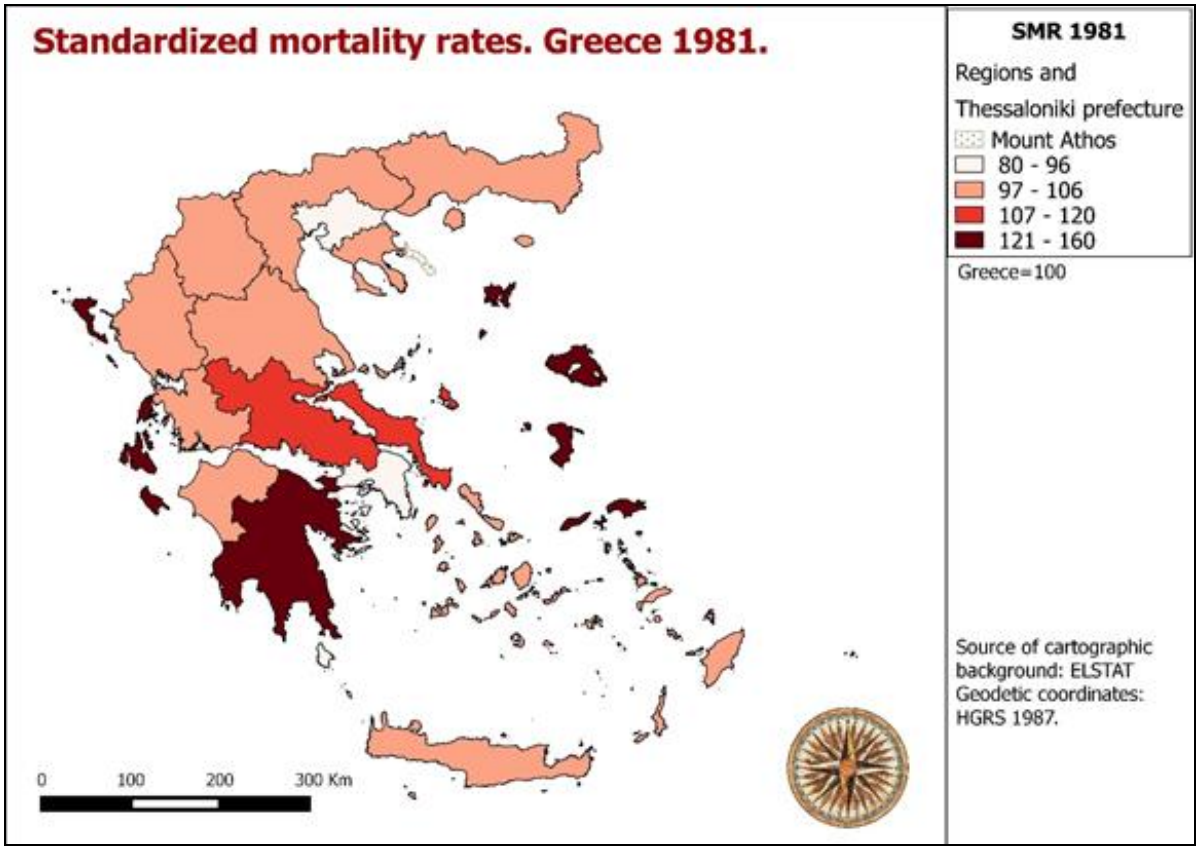

Figure 7: Standardized Mortality Rates by Region and the Prefecture of Thessaloniki. Greece 1981.

In 1981 Attica (where Athens is located) and Thessaloniki were the only areas with lower mortality than the national average (figure 7). Thessaloniki had 17% lower mortality than the national average (SMR=83) and Athens 12% lower (SMR=88). The Region with the highest mortality was North Aegean (SMR=160), followed by the Ionian islands (SMR=151), Peloponnesus (SMR=126) and Central Greece and Euboea (SMR=111). The Remaining eight Regions recorded mortality levels that were around the national average.

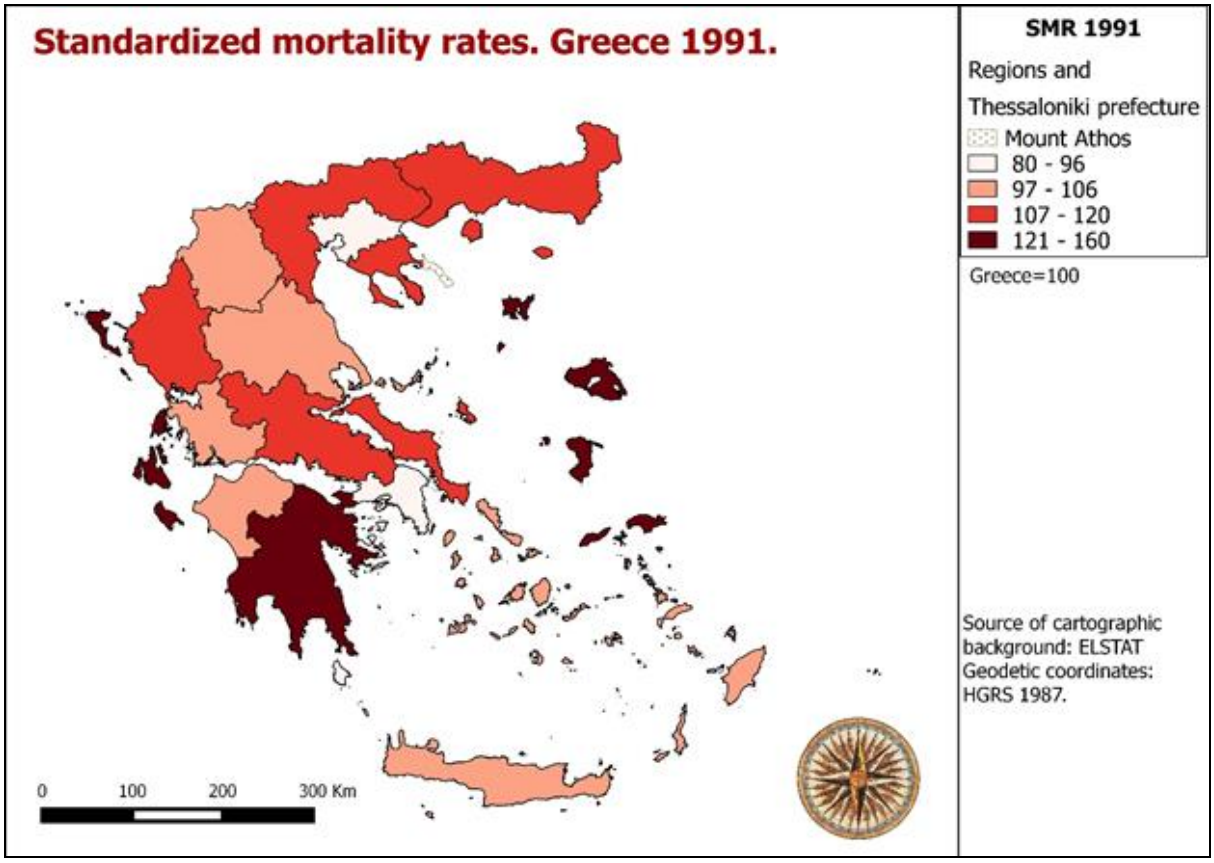

Figure 8: Standardized Mortality Rates by Region and the Prefecture of Thessaloniki. Greece 1991.

In 1991 the two main urban centers of Greece (Athens and Thessaloniki) remained the only areas with lower mortality than the national average (figure 8). North Aegean, the Ionian islands and Peloponnesus kept their place as the Regions with the highest mortality (more than 20% than the national average). More Regions presented mortality rates that were 7% to 20% higher than the national average and only five were around the national average. However, regional variations in mortality in 1991 were less acute than in 1981, as the standard deviation in table 2 attests.

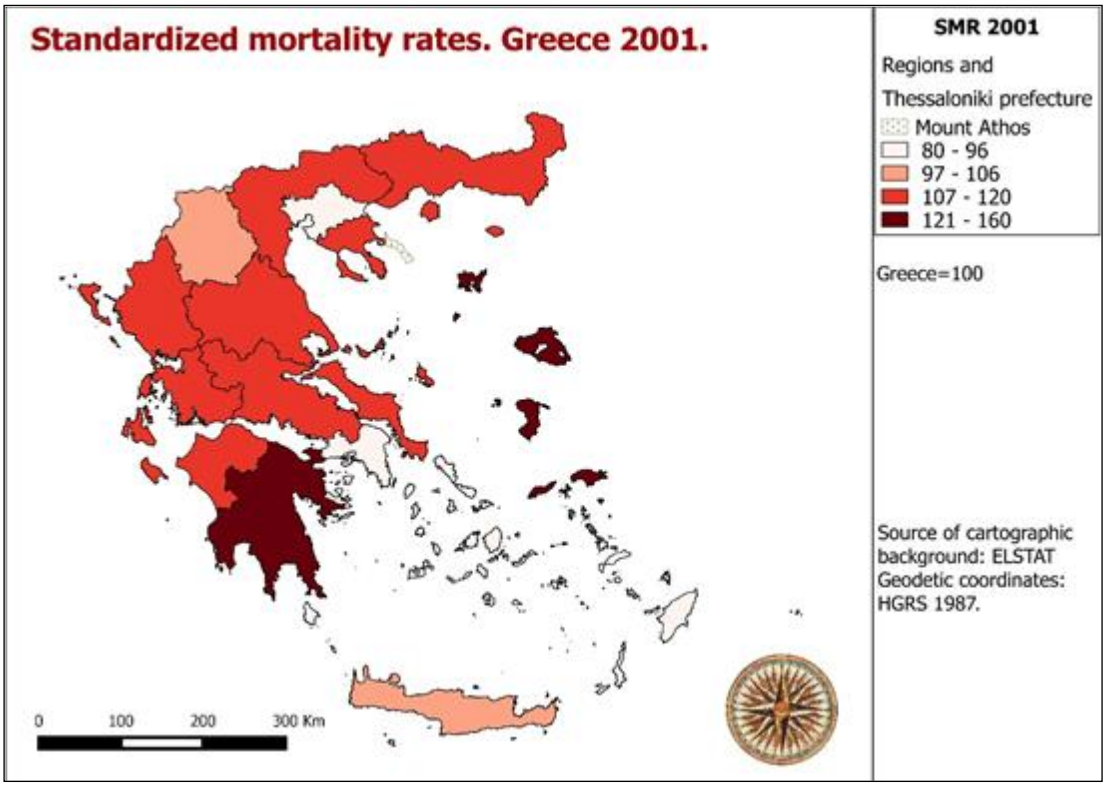

Figure 9: Standardized Mortality Rates by Region and the Prefecture of Thessaloniki. Greece 2001.

In 2001 South Aegean joined Athens and Thessaloniki in the group of areas that exhibited lower than the national average mortality (figure 9). North Aegean and Peloponnesus were the only Regions with considerably higher mortality than the national average. In 2001 regional variation in Greece's mortality was less acute than in the previous decades (see table 2).

In 2014 no Region deviates more than 15% from the national average. Regional variation, as measured by standard deviation (table 2), is the minimum recorded in the examined period (1981-2014).

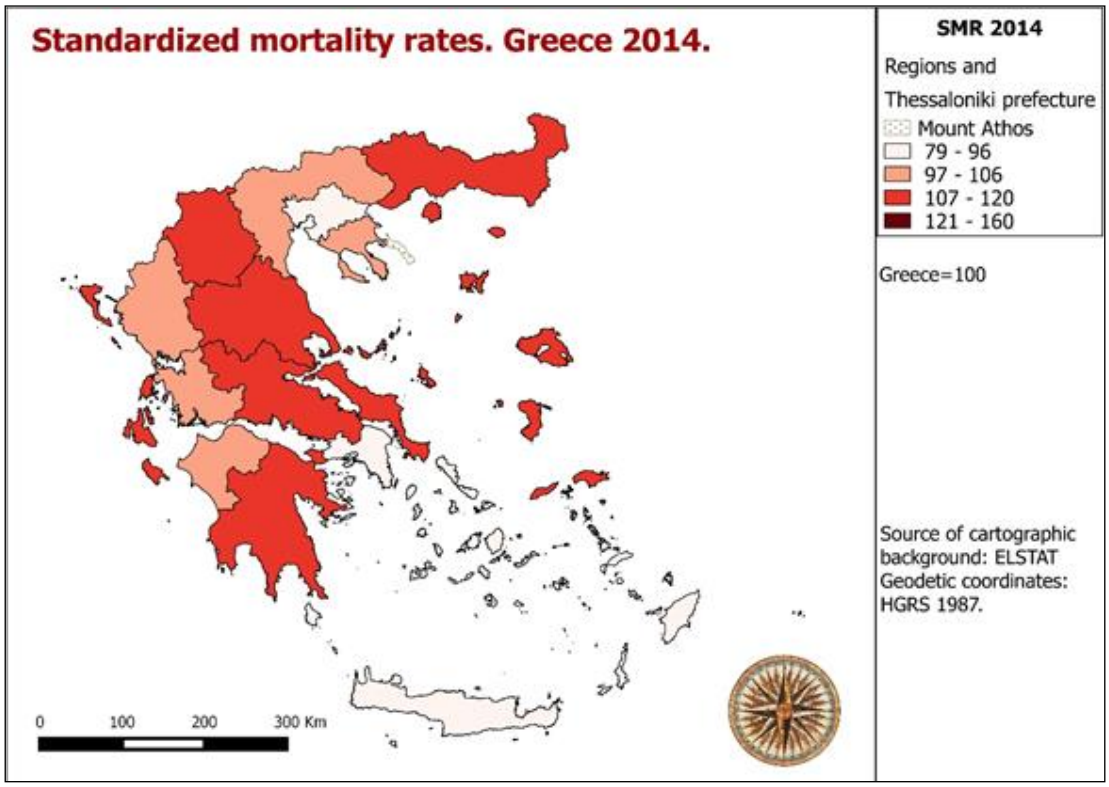

Figure 10 : Standardized Mortality Rates by Region and the Prefecture of Thessaloniki. Greece 2014.

Table 2 : Standardized Mortality Rates (SMRs) and their measures of dispersion from 1981 to 2014. (Greece=100).

Region	**SMR 1981**	**SMR 1991**	**SMR 2001**	**SMR 2014**
Eastern Macedonia and Thrace	106	113	114	111
Attica	88	89	91	94
North Aegean	160	145	133	115
West Greece	104	104	107	104
West Macedonia	104	104	105	109
Epirus	104	108	109	105
Thessaly	103	104	111	109
Ionian islands	151	135	114	113
Central Macedonia (without Thessaloniki)	99	107	111	100
Crete	104	97	97	88
South Aegean	100	97	80	79
Peloponnesus	126	128	126	114
Central Greece and Euboea	111	114	115	108
Thessaloniki (Prefecture)	83	80	80	87
Greece	100	100	100	100
Min	**83**	**80**	**80**	**79**
Max	**160**	**145**	**133**	**115**
St. Deviation	**21.6**	**17.5**	**15.3**	**11.3**

Source: mid-year estimates and age-specific deaths provided by ELSTAT.

3.3 The relationship between mortality and socio-economic development

The above analysis on regional variations in mortality raises questions on the etiology of these variations. Three possible reasons are held responsible for the regional variations in mortality, namely GDP per capita, number of physicians per 100,000 population and number of hospital beds per 100,000 population. There are of course many more factors which may cause mortality to vary from one region to another in the same country: environmental factors, like the climate of an area, the pollution of atmosphere and water with any king of industrial waste and chemical substances. Yet, it is mainly the factors that are associated with the socio-economic development that concern us in this paper.

Table 3 correlates mortality (as measured by the Standardized Mortality Rates, SMR) in 2001 with GDP per capita (as measured by the Purchasing Power Standard per inhabitant, PPS) and with the number of physicians per 100.000 population. It is obvious from the bivariate correlations shown in table 4, that only the GDP per capita was correlated with regional variations in mortality in a non-random way ($r = -0.66$, $p<0.05$) in 2001. The variation in mortality from one region to another could not be explained by the variation in the relative number of physicians because the correlation coefficient was not statistically significant ($r=-0.24$, $p=0.427$, see table 4). This finding becomes more interesting when one notices that the relative number of physicians from one region to another presents greater variation that GDP per capita (the coefficient of variation equals 24 for the former and 17 for the latter). This could mean that access to health services was more depended on someone's income rather than on availability of doctors.

Table 3: Standardized Mortality Rates (SMRs), physicians per 100.000 inhabitants and Purchasing Power Standard per capita (PPS p.c.) in euros. Greece 2001.

Region	SMR	Physicians per 100000	PPS p.c. in euros
Greece	100	437	17900
Eastern Macedonia and Thrace	114	310	13700
Central Macedonia	111	453	14900
West Macedonia	105	236	15700
Epirus	109	306	13600
Thessaly	111	446	13900
Ionian islands	114	308	18200
West Greece	107	351	13400
Central Greece and Euboea	115	251	18900
Peloponnesus	126	298	14900
Attica	91	579	22600
North Aegean	133	313	13100
South Aegean	80	241	20700
Crete	97	452	16500
St. deviation	14	103	3054
Coefficient of variation	14	24	17

Source: EL.STAT. Own elaboration

Table 4: Correlation of mortality (SMR) with socio-economic development. Regions of Greece 2001

SMR	physicians per 100,000	PPS p.c. in €
Pearson's r	-0.24	-0.66
p-value	0.427	0.015

Source: Data from table 3

For 2014 there is one more explanatory variable, namely the number of hospital beds per 100,000 population (table 5). Once again only the GDP per capita was a statistically significant explanatory variable for the regional variations in mortality ($r=-0.55$, $p<0.05$, see table 6). It is noteworthy, however, that correlation between income and mortality is not as strong in 2014 as it was in 2001, although the regional variations of income in 2014 are greater than those in 2001 (coefficient of variation equals 19 for 2014 versus 17 for 2001). This finding in conjunction with the fact that mortality presents less regional variations in 2014 than in 2001 (c.v.=11 for 2014 and 14 for 2001), may indicate that the national health system became more effective between 2001 and 2014. The other two variables (availability of doctors and availability of hospital beds) are not statistically significant, although the correlation of available doctors with regional variations in mortality is stronger in 2014 than in 2001.

Table 5: Standardized Mortality Rates (SMRs), physicians per 100.000 inhabitants, hospital beds per 100.000 inhabitants and Purchasing Power Standard per capita (PPS p.c.) in euros. Greece 2014.

Region	SMR	physicians per 100000	PPS p.c. in euros	Hospital beds per 100000
Greece	100	632	19900	424
Eastern Macedonia and Thrace	111	480	13700	406
Central Macedonia	100	605	15300	432
West Macedonia	109	298	18100	423
Epirus	105	667	14000	418
Thessaly	109	496	15100	518
Ionian islands	113	429	18400	269
West Greece	104	548	14800	298
Central Greece and Euboea	108	302	16900	171
Peloponnesus	114	359	15900	240
Attica	94	870	27100	520
North Aegean	115	396	15700	314
South Aegean	79	325	22000	321
Crete	88	631	17300	392
St. deviation	11	169	3692	105
Coefficient of variation	11	27	19	25

Source: EL.STAT. Own elaboration

Table 6: Correlation of mortality (SMR) with socio-economic development. Regions of Greece 2014.

SMR	physicians per 100,000	PPS p.c. in €	Hospital beds per 100000
Pearson's r	-0.30	-0.55	-0.21
p-value	0.328	0.049	0.498

Source: Data from table 5

4. DISCUSSION

The paper inspected regional variations in mortality in Greece in the last 34 years (1981-2014). Greece used to have a history of unequal mortality rates in regional level, although there was no standard geographical pattern to this inequality. The Regions that presented higher than the national average mortality were scattered all over the country. It is not only the North and the Northeast of the country, namely the Regions of East Macedonia and Thrace, and the North Aegean, which were lagging behind the National Average, as far as the general mortality is concerned. The Ionian islands, Peloponnesus and, to a lesser extent Central Greece and Euboea, presented higher than average mortality all over the examined period (1981-2014) in terms of Standardized Mortality Rates. However, a continuous descending course of regional variations in mortality is more than obvious from 1981 to 2014. In 2014 the Region with the highest mortality, recorded only 15% higher mortality than the national average, while in 1981 this figure was 60%.

When it comes to infant mortality, it is worth noting that the two main urban centers of Greece, Athens and Thessaloniki, presented higher than average infant mortality for most of the examined period. Neither of the two cities has ever presented lower than the national average infant mortality. The marginally lower IMR of Attica in 2012-14 (3.2‰ in Attica versus 3.4‰ in Greece) is not enough to establish a substantially lower IMR than the national average, and Thessaloniki was always above the national average. On the other hand, the two urban centers had always lower SMRs than the national average. The case of Thessaloniki is even more intriguing because its SMR was always by far lower than the SMR of Central Macedonia (the Region where Thessaloniki belongs) while its IMR was usually higher than that of Central Macedonia. This fact poses further research questions regarding the reasons for this inconsequence.

Regarding the effect of the economic crisis that inflicts Greece since 2009, stagnation is observed in the national infant mortality rate between 2009-11 and 2012-14, which is accompanied with an increase in regional variations. An increase in infant mortality between 2008 and 2010 is shown by the IMRs of these two years (2.7‰ in 2008 vs 3.8‰ in 2010) and this increase is attributed by certain scholars to the economic crisis, which caused rapid upsurge in unemployment, cuts in public health expenditures and concomitant reductions in the number of healthcare workforce and their salaries (Kentikelenis, et al. 2014). However, a closer examination of the data shows that the increase in infant mortality between 2008 and 2010 is partly due to an inherent shortcoming of the conventional infant mortality rate (IMR). The conventional IMR does not satisfy the principle of correspondence, meaning that the events in the numerator of the index (infant deaths) do not necessarily correspond to the population in the denominator (live births). The infant deaths recorded in 2010 came from births that took place both in 2010 and in 2009. The latter was a year with more births than 2010 (117,439 in 2009 versus 114,551 live births in 2010) and therefore the infant deaths that were recorded in 2010 (434) were more numerous than those corresponding to the births of 2010, thus giving an inflated IMR (3.8‰). The opposite is the case with the IMR of 2008, which was a year with considerably more birth than 2007 (117,913 vs 111,517). The conventional IMR for 2008 was low (2.7‰) reflecting the fluctuation of births from one year to another. A more reliable method to calculate IMRs is to use data for three consecutive years so as to reduce the effect of any fluctuation of births from one year to another. By employing this method in our analysis, the national infant mortality rate does not increase between 2009-11 and 2012-14. The only change that might be attributed to the economic crisis is that most Regions raised their IMR in this period, although the national IMR was not raised. It is the Region of Attica (which makes up 35.4% of the country's population) together with three more Regions (Thessaly, Central Greece and Euboea, and the Ionian islands) that

achieved some improvements in IMR in the period between 2009-11 and 2012-14 and balanced out the negative developments in the rest of the Regions (table 1).

Despite these geographical variations and the negative effects of the recent and ongoing economic crisis, in the long run (1981-2014) there was a spectacular drop in infant mortality and this drop, in conjunction with the reduced regional variations since 1981, is evidence of improvements in the socio-economic status of the population and a more homogeneous access to health services irrespective of the region that someone lives. The only dark spot is the period 2009-2014, where regional variations in infant mortality increased and the national rate of infant mortality did not record any reductions. It remains to be seen whether in the immediate future infant mortality resumes its descending trend or the effects of the economic crisis in the health system of Greece become even more acute.

However, one should not overlook the progress that has been achieved in the last 35 years in the National Health System of Greece. The continuous descending course of regional variations in mortality, in conjunction with the constant increase in life expectancy at birth, is evidence that the health system in Greece has become more effective and more accessible to everyone across the country. From the 1980s onwards standard deviation around the national mortality rate has declined from 21.6 to 11.3 in the Regional level. In 1981 the Region with the highest mortality had had 60% higher mortality than the national average. In 2014 the Region with the highest mortality, which happens to be the same all over the examined period, that of North Aegean, recorded only 15% higher mortality than the national average. This achievement implies great efforts to improve the health services in remote place of Greece, and especially in the islands. A study focused on the regional hospitals and health centers and their effectiveness throughout the last 40 years would shed more light on this issue.

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