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TRAP

Assessment for basic demographic, health and public health profile

TRAP

Transboundary Air Pollution Health Index Development and Implementation

March 2020

The project is co-funded by the European Union and by National Funds of the participating Countries

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1. Introduction

1.1 Project Overview

Information on real time air pollution levels is now more necessary than ever before. At present, air pollution is one of the most significant factors posing threat to the health of individuals worldwide. It is associated with a range of diseases, symptoms and conditions that impair health and quality of human life. According to the WHO, outdoor air pollution was responsible for the deaths of some 3.7 million people under the age 60 around the world in 2012, representing 6.7% of the global disease burden while outdoor air pollution combined are among the largest risks to health worldwide. Apart from habitant's air quality impacts natural environment and biodiversity. The main sources of air pollution at both countries are mainly caused by industrial activities, transportation and heating.

Air Pollution has been recognized as of the most pressing problems in both Greece and the Republic of North Macedonia, following the economic and social development of the two countries the sources of air pollution are mainly industrial activities, transport and central heating. The major challenges of transport in urban areas are the rising number of vehicles, their increased average age and traffic congestion. Air quality problems from industrial sources mainly concern areas with thermos-electrical power stations and industrial units located close to residential areas. Air quality is strongly influenced by pollutants trapped due to thermal inversions caused by from land local breezes and thermal internal boundary layers.

TRAP developed on the necessity for developing ICT applications in environmental protection, monitoring and management of the eligible areas. Environmental initiatives is a privileged field for developing cooperation in the cross-border area contributing significantly to economic and social development of the population and public health, therefore, the opportunity for mutual cooperation and understanding between public authorities, scientific institutions and residents of the area. The major challenge is the development of an integrated approach including air quality monitoring with providing health indicator for vulnerable groups of the population. TRAP project addresses a series of issues, such as:

- Identification of the emission sources and development of regional and CB emission for vulnerable groups of the population
- Assessment of each emission source

- Development of air quality plans
- Monitoring data, validation and analysis
- Basic demographic, health and public health profile
- Air quality and Health Indicators
- Joint CB comparative analysis
- Capacity Building at user level (Health and authority stakeholders)
- Air quality and health sensitization campaigns
- Protection of human health
- Citizen involvement
- Implementation of air quality directives

Partners aim to improve management and protection of areas in both countries by establishing air quality monitoring networks. The measurements of all station in areas involved in this project will create a system that will display real-time measurements through the internet. Moreover, epidemiological indicators and indicators of air quality, based on the effects of air pollution on human health, will be calculated and displayed on the web. The best way for someone to use an Air Pollution Health Indicator (APHI) is to regularly check the current index value, to pay attention to personal symptoms and self –calibrate to personal symptoms and self-calibrate to the report current APHI value. Therefore, the strategic objective of TRAP project is the creation of an ICT application integrating Air Quality Monitoring with Air Pollution Health Indicator) (APHI) in CB area.

The specific sub-objectives of the project are to:

- Develop and evaluate emission inventories at partner areas
- Assess the health risk related to air quality measurements
- Create integrated ICT tool including air quality information correlated to possible health impacts and providing emergency mechanism to policy makers and vulnerable groups
- Evaluate the CB conditions regarding air quality and transported pollution in CB areas
- Engage relevant stakeholders in order to inform them on the created tool operation and indexes
- Disseminate and communicate the project results to key stakeholders as well as to the general public and vulnerable groups

TRAP project results will positively affect and contribute to the programmes result indicator for ecosystems with improved protection status for the eligible areas of Florina, Bitola and Gevgelija where the monitoring stations will be placed. The innovative character of TRAP is served by its approach that favours the interaction and exchange of ideas as well as the knowledge diffusion and integration among the targeted stakeholders. Many of the project activities will be jointly implemented creating unified framework for problem resolutions and providing added value to the CB area as a total. The expected results are focused on the development of an ICT tool for better air quality monitoring in CB area integrated with Air pollution Health Indicator.

1.2 Purpose of the Deliverable 5.3.1

Ambient air pollution is considered as a major negative factor in human health. TRAP project has as major objective to establish four (4) monitoring atmospheric pollution stations in order to improve the management and protection of the areas of Florina, Bitola and Gevgelija. Also, the development of an ICT application integrating Ai Quality Monitoring with Air Pollution Health Indicator is a major objective, providing the information by a tool displaying real-time air-quality measurements. In order for these tools to be developed it is needed a monitoring of epidemiological indicators and indicators of air quality, based on the effects of air pollution in human health. It is essential for the project objectives to be accomplished to be developed a study in the CB area, regarding the health profile of citizens.

Furthermore, it is important, a basic assessment to be conducted in the field of demographic, health and public health profile of the targeted areas. Hence, in this study, the objective is an analysis to be developed in the Greater area of Thessaloniki, regarding the main characteristics of the area, the demographic characteristics of the citizens (age distribution, births, deaths, vital index, life expectancy), the socioeconomic indicators (e.g. equal opportunities and access to the labour market) and the general image of Thessaloniki to be described, such as the infrastructure of transportation connections, the economic activities, the local climate, the environmental risks. In addition, the morbidity and mortality are analyzed according to the available bibliography and sources (Eurostat, Hellenic Statistical Agency, scientific articles, other reports, etc.).

Hospitals' data, such as the patients' incomes, the type of disease that outcome patients had, causes of death and other related data from hospitals of the Greater area of Thessaloniki such as "Papageorgiou", "Hippocrates", "Gennimatas", "Agios Dimitrios", "Agios Pavlos", "Papanikolaou", "AHEPA", are presented and analyzed.

2. Main Characteristics of the Target Area

Thessaloniki is the second largest Greek city and has the second largest commercial port. The city is characterized by intense vehicular traffic in the center and several industrial units located in the West, North-West and North. Thessaloniki is the capital of the region of Kentriki Makedonia. As a region, Central Makedonia, with a total area of 18,810.52 km2, is the second most important region of the country in terms of population (1,880,122 inhabitants in 2017 (Eurostat, 2018)) and economic activity. Thessaloniki, the capital of the region, is an important commercial and transport hub of south-eastern Europe. In parallel, the region is also an innovation hub with considerable public research infrastructures and the largest University of Greece, i.e. Aristotle University of Thessaloniki.

Map 1 Region of Central Macedonia and Regional Unite of Thessaloniki

Thessaloniki is located on the Thermaic Gulf, at the northwest corner of the Aegean Sea. It is bounded on the west by the delta of the Axios/Vardar. The municipality of Thessaloniki, the historical center, had a population of 325,182 in 2011, while the Thessaloniki Urban Area had a population of 824,676 and the Thessaloniki Metropolitan Area had 1,030,338 inhabitants in 2011. It is Greece's second major economic, industrial, commercial and political centre; it is a major transportation hub for Greece and southeastern Europe, notably through the Port of Thessaloniki. The city is renowned for its festivals, events and vibrant cultural life in general, and is considered to be Greece's cultural capital. Events such as the Thessaloniki International

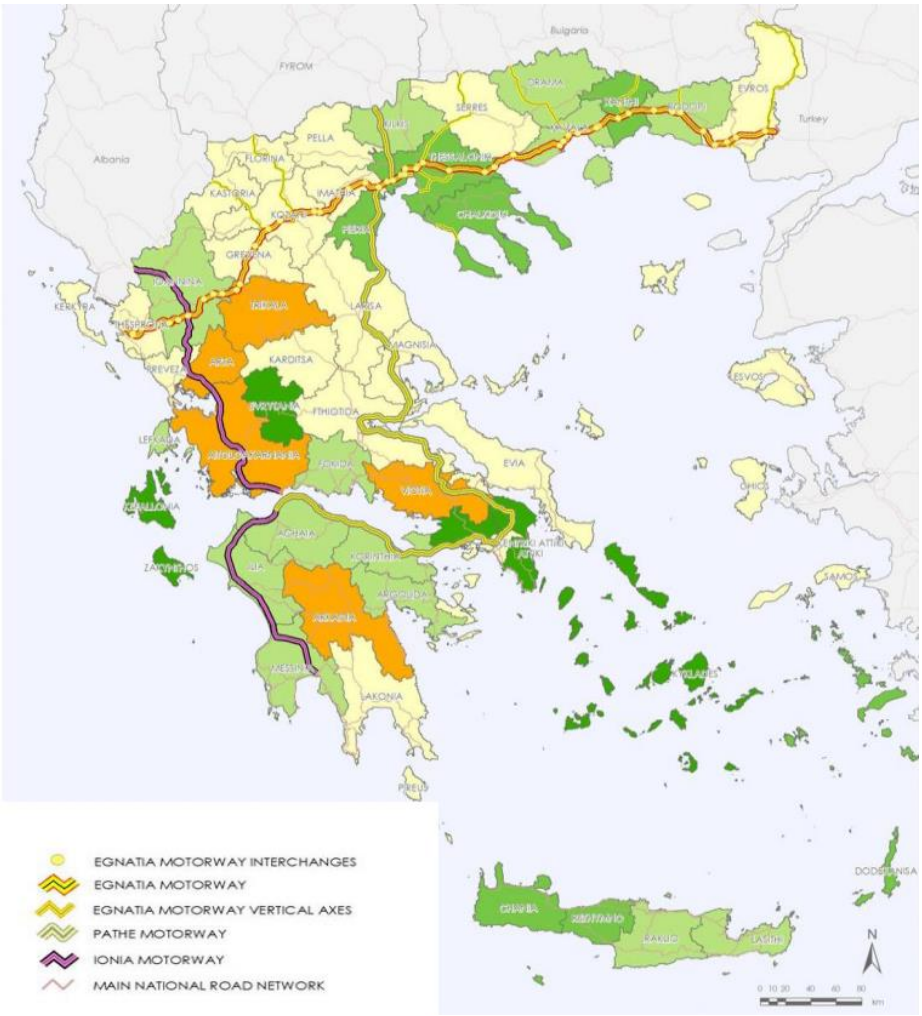
Fair and the Thessaloniki International Film Festival are held annually, while the city also hosts the largest bi-annual meeting of the Greek diaspora. Thessaloniki was the 2014 European Youth Capital (Wikipedia, 2019).

2.1. Transportation connections

Road Infrastructure

One of the main road connections is the Patras-Athens-Thessaloniki-Evzonoi motorway (PATHE), a North-South axis (730 km) crossing the Regions of Central Macedonia, Thessaly, West Greece, Central Greece, the Peloponnese and Attica. In the following map are presented the major road connections in Greece (Csil, 2012).

Map 2 Road Infrastructure



(Centre for Industrial Studies, 2012)

More specifically for the greater area of Thessaloniki, the Egnatia motorway is a high-speed four-lane motorway with a length of 670 km and a width of 24.5 m (or 22 m along mountainous adverse sections). From its starting point at Igoumenitsa (Epirus Region), the Egnatia motorway runs through the Prefectures of Thesprotia, Ioannina, Grevena, Kozani, Imathia, Thessaloniki, Serres, Kavala, Xanthi, Rodopi and Evros, to the village of Kipoi on the Turkish border. In total, it crosses five Greek regions: East Macedonia & Thrace, Central Macedonia, West Macedonia, Epirus and Thessaly. These are the most mountainous regions in the country and account for 50% of the national territory, 36% of the national population and 33% of the national Gross Domestic Product.

Map 3 Road infrastructure of northern Greece

(Centre for Industrial Studies, 2012)

The Egnatia motorway is connected to the rest of Greece via the PATHE motorway and the Western axis of the Ionian motorway (at the A2- Ioannina interchange), and with the islands of the Aegean and Ionian seas through sea corridors starting from the ports of Alexandroupoli, Kavala, Thessaloniki, and Igoumenitsa. Moreover, it links six airports36 and serves several industrial zones37 and tourist areas. In the North-South direction, it is complemented by 9 vertical axes, with a total length of about 658km, connecting Greece with the Balkan and European countries. Most of the vertical axes are part of the Pan-European Corridors, namely Corridors IV (Vienna-Thessaloniki), VIII (Durrës-Varna), IX (Helsinki-Alexandroupoli) and X (Berlin-Thessaloniki). They are national motorway roads, partly still under construction. Finally, the Egnatia motorway is linked to the surrounding Black Sea Area though the Black Sea Ring highway, which is a four-lane ring motorway, approximately 7,000 km long, extending in the Black Sea Economic Cooperation (BSEC) Member States, with vertical axes to Azerbaijan, Serbia and Albania. The Black Sea Ring Highway is currently under construction and is expected to intersect Egnatia motorway at Alexandropoli, Komotini (Csil, 2012).

Train

The main railway axis in Greece is Patras-Athens-Thessaloniki Idomeni/Promachnonas (PATHE/P), which is part of the Trans-European rail network and connects the most economically dynamic regions of Greece, namely the wider Athens Area (Athens – Piraeus) with Thessaloniki and Patras, the latter being one of the country's Western gateways to Italy and Western Europe. Another relevant rail network is the Thessaloniki Alexandroupoli-Ormenio line, running along the Northern part of Greece and providing connections with Bulgaria and Turkey (Csil, 2012).

Map 4 Railway axis

(Centre for Industrial Studies, 2012)

TrainOSE S.A is a railway company in Greece which currently operates all passenger and freight trains on OSE lines. TRAINOSE operates, in cooperation with the Railways Undertakings of neighboring countries, international train services between Thessaloniki – Sofia, Thessaloniki – Skopje – Beograd and Thessaloniki – Sofia – Bucharest (Csil, 2012).

Airport

Thessaloniki Airport officially Thessaloniki Airport "Makedonia" and formerly Mikra Airport, is an international airport serving Thessaloniki, the second-largest city in Greece. It is located 13 km (8.1 mi) southeast of the city, in Thermi.

The airport is the third-largest airport in the country after Athens International Airport and Heraklion International Airport. It opened in 1930 and was the second-busiest airport in Greece in terms of flights served and the third-busiest in terms of passengers served in 2016, with over 6 million passengers. It is the main airport of Northern Greece and apart from the city of Thessaloniki it also serves the popular tourist destination of Chalkidiki and the surrounding cities of Central Macedonia. The Athens–Thessaloniki route is the tenth busiest in the EU with 1.8 million passengers. To cope with demand, a second terminal is currently under construction as part of a billion-euro investment by Fraport Greece, the company which operates the airport (Wikipedia, 2019).

Air traffic statistics

In the next table is presented the traffic development overview regarding the comparative passengers 2018 to 2019 (SKG, 2019).

Table 1 Air traffic statistics

Passengers	Domestic			International		
Month	2019	2018	%Δ	2019	2018	%Δ
JANUARY	173.030	157.951	9,5%	215.278	151.674	41,9%
FEBRUARY	168.834	157.655	7,1%	199.307	138.879	43,5%
MARCH	190.487	186.685	2,0%	247.207	199.784	23,7%
APRIL	167.493	184.229	-9,1%	356.006	337.670	5,4%
MAY	174.422	193.035	-9,6%	443.416	416.518	6,5%
JUNE	185.523	196.997	-5,8%	525.755	501.034	4,9%
TOTAL SKG	1.059.789	1.076.552	-1,6%	1.986.969	1.745.559	13,8%

(SKG, 2019)

The international traffic by country from the Thessaloniki's Airport is presented.

Table 2 The international traffic by country from the Thessaloniki's Airport

	Aircraft	Passengers		
Country	***Arr - Dep***	***Arriving***	***Departing***	***Transit***
Germany	693	42,296	52,105	-
Cyprus	189	13,802	13,342	-
Great Britain	107	7,925	8,990	-
Italy	128	7,230	8,280	1
Netherlands	50	3,264	4,274	-
Austria	68	3,669	3,748	1
Turkey	80	3,473	3,579	-
Russia	91	3,213	3,774	1
Belgium	38	2,801	3,047	-
France	27	1,814	1,833	-
Hungary	22	1,475	1,519	-
Georgia	18	1,483	1,327	-
Sweden	23	892	1,858	-
Poland	19	1,195	1,382	-
Slovakia	19	1,125	1,259	-
Israel	22	915	1,076	-
Serbia	39	663	989	-
Romania	43	770	778	-
Czech Republic	12	775	597	-
Qatar	24	593	708	-
Denmark	8	231	559	-
Egypt	4	185	-	1
Albania	1	157	-	-
Switzerland	5	146	3	2
Other Countries	*24*	*41*	*66*	*24*
Grand Total	**1,754**	**100,133**	**115,093**	**30**

(Fraport, n.d.)

Port

For 2300 years, since its foundation in 315/6 BC and up until today, the port of Thessaloniki constitutes the most important port in Macedonia and one of the most important ports in Southeast Europe.

Due to its advantageous geographical location and its excellent road links and train connections, it is the largest transit-trade port in the country, and it services the needs of approximately 15 million inhabitants of its international mainland.

It is located on the inner part of the Bay of Thermaicos, on the northern section of the Eastern Mediterranean Sea, to the west of the center of the city of Thessaloniki. Approach of the ships is accomplished through a natural channel of substantial depth, not needing thus any further deepening.

It occupies a total space of 1.5 million square meters, and it spreads across a length of 3.5km.

The installations include 6 piers spreading on a 6200-meter-long quay and a sea depth down to 12 meters, with open and indoors storage areas spreading on a total of 600,000 square meters, suitable for servicing all types of cargo as well as passenger traffic.

The port also has installations suitable for liquid fuel storage and it is located in proximity to the international, natural-gas pipeline.

Due to the temperate climate, the well protected from weather conditions approach, the existence of a 1000m-long wave breaker which protects the port from the southern winds, the almost null tide, (maximum height of 0.7m) and the port's secure installations, the loading and unloading of cargoes as well as the embarkment/disembarkment of passengers on the ships are taking place unhindered, throughout the year.

The Free Zone (control type I: fencing, customs' supervision and cargo inspection on the points of entrance – exit, inspection of persons and vehicles) is also part of the port of Thessaloniki and it is operating since 1995 in accordance with the Community Customs Code.

It is linked to a dense, traffic network that is directly linked to the national and international road network, bypassing thus city entrance.

All the port quays have double/triple rail-lines and are linked to the national and international railroad network.

The port enjoys a privileged position being located at the crossroad of land transportation networks, as follows: East to West, (Egnatia Motorway) και Νότου-Βορρά (PATHE Motorway Patras-Athens-Thessaloniki-Evzoni or Idomeni) which continues towards the north, not only as an eastern corridor – Eastern Mediterranean, of the Central network of the Trans-European Transport Networks (TEN-T Core Network Corridor Orient - East Med), but also as the pan-European route Ten X.

It has been characterized as a Port of National Interest in the Country's Coast-guard System, (National Gazette ΦΕΚ 202Β/16.2.07) and one of the five Greek ports, which belongs to the Core Network of Trans-European Transport Networks.

It is located at a distance of 1km from the Passenger Railway Station and 16km from the city's International Airport (Thessaloniki Port Authority, n.d.).

View of Thessaloniki's Port

Port statistics

Table 3 Concise Statistical Data March 2019

Year	2019	2018	Difference	
Period	January-March	January-March	Total	%
ThPA Piers (tonnes)				
Conventional cargo (without Passenger Ro-Ro)	1.203.740	795.964	407.776	51,23
Passenger Ro-Ro	19.550	24.630	-5.080	-20,63
Containers (in tonnes)*	916.861	830.571	86.290	10,39
Total tonnage	**2.140.151**	**1.651.165**	**488.986**	**29,61**
Other Piers (tonnes)				
Private Cement Pier	40.200	46.458	-6.258	-13,47
Private liquid fuel installation	1.916.926	2.061.892	-144.966	-7,03
Containers				
Containers (units)	72.670	69.993	2.677	3,82
Containers (TEU)	108.737	102.877	5.860	5,70
Port Traffic (TEU)**	108.645	102.864	5.781	5,62
Vessels				
ThPA Piers	343	310	33	10,65
Private Cement Pier	10	17	-7	-41,18
Private liquid fuel installation	117	114	3	2,63
Total	**470**	**441**	**29**	**6,58**
Passsengers	**0**	**0**	**0**	-

(Thessaloniki Port Authority S.A., 2019)

*Tare weight not included

**Transshipment units are counted once

2.2. Economic activities in Thessaloniki

The service sector accounts for nearly two thirds of the total labour force of Thessaloniki. Of those working in services, 20% were employed in trade, 13% in education and healthcare, 7.1% in real estate, 6.3% in transport, communications & storing, 6.1% in the finance industry & service-providing organizations, 5.7% in public administration & insurance services and 5.4% in hotels & restaurants (Hatziprokopiou, 2006).

Thessaloniki still remains a major business hub in the Balkans and Greece, with a number of important Greek companies headquartered in the city, such as the Hellenic Vehicle Industry (ELVO), Namco (automobiles), Astra Airlines, Ellinair, Pyramis and MLS Multimedia, which introduced the first Greek-built smartphone in 2012.

In the middle 60s, with the collaboration of Standard Oil and ESSO-Pappas, a large industrial zone was created, containing refineries, oil refinery and steel production. The zone attracted also a series of different factories during the next decades. Today the oil refinery is owned by the Hellenic Petroleum. Titan Cement has also facilities outside the city.

Foodstuff companies headquartered in the city include the Macedonian Milk Industry, Allatini, Barbastathis, Hellenic Sugar Industry, Mythos Brewery, while the Goody's chain started from the city. The American Farm School also has an important contribution in food production (Hatziprokopiou, 2006).

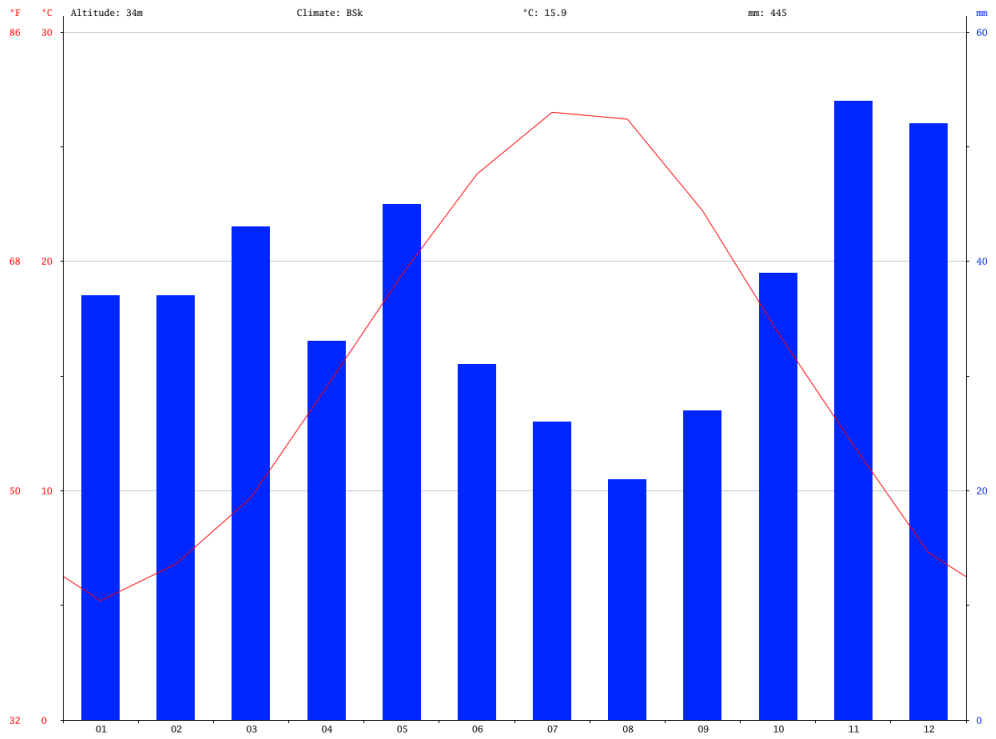
The Thessaloniki International Fair

The Thessaloniki International Fair, is an annual international exhibition event held in Thessaloniki, Greece's second-largest city. It has been held in the first week of September since 1926, and its opening is traditionally marked by a series of programmatical statements by the Prime Minister of Greece. The United States were chosen as the honored country for the 83rd Fair, opened on 8 September 2018 and India will be the honored country for the 84th TIF in 2019.

2.3 Climate

Thessaloniki's climate is considered to be a local steppe climate. In Thessaloniki, there is little rainfall throughout the year. According to the Köppen climate classification, it has a humid subtropical climate (Cfa) that borders on a Mediterranean climate (Csa), as well as a semi-arid climate (BSk), observed on the periphery of the region, while the average annual temperature is 15.9 °C. Precipitation here averages 445 mm.

Figure 1 Rainfall meanl by month

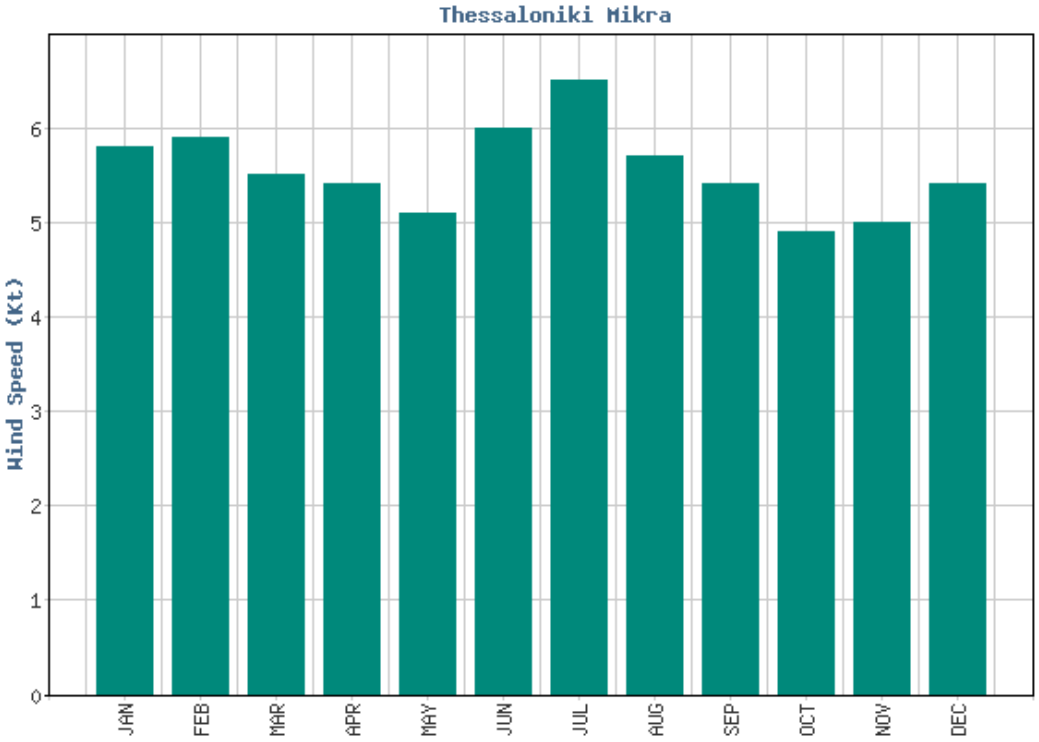


(climate-data, n.d.)

The driest month is August, with 21 mm of rain. With an average of 54 mm, the most precipitation falls in November. Winters are relatively dry, with common morning frost. Snowfalls occur sporadically more or less every winter, but the snow cover does not last for more than a few days. Fog is common, with an average of 193 foggy days in a year (climate-data, n.d.).

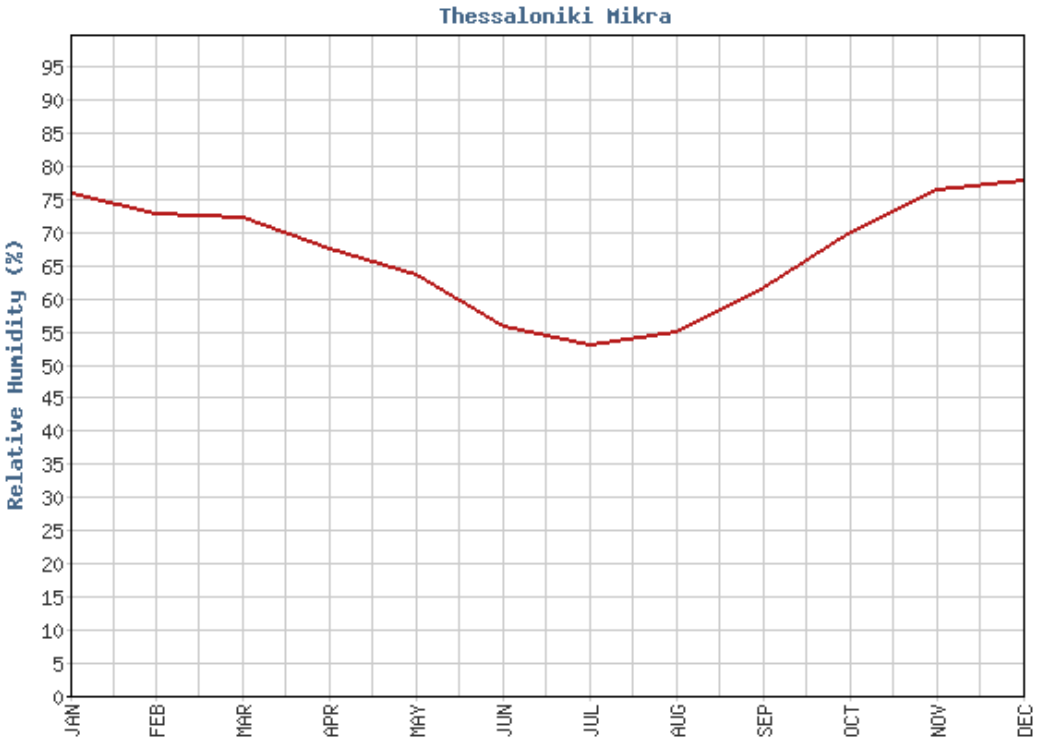
Thessaloniki's summers are hot with rather humid nights. Maximum temperatures usually rise above 30 C (86 °F), but rarely go over 40 °C (104 °F); the average number of days the temperature is above 32 °C (90 °F) is 32. The maximum recorded temperature in the city was 42 °C (108 °F). Rain seldom falls in summer, mainly during thunderstorms. In the summer months Thessaloniki also experiences strong heat waves. The hottest month of the year in the city is July, with an average 24-hour temperature of 26 °C (79 °F). The average wind speed for June and July in Thessaloniki is 20 kilometers per hour (12 mph) (Wikipedia, n.d.).

Figure 2 Monthly Mean Wind Power



Monthly Mean Wind Power diagram in the area of Thessaloniki from Hellenic Nation Meteorological Service (HNMS, n.d.).

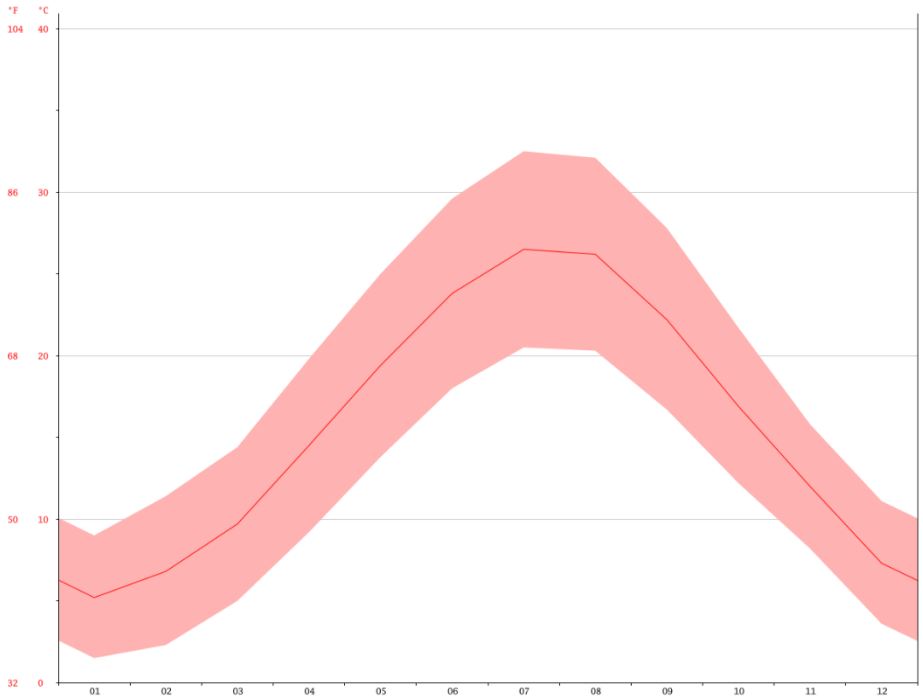
Figure 3 Monthly Mean Humidity



(HNMS, n.d.)

Monthly Mean Humidity diagram in the area of Thessaloniki from Hellenic Nation Meteorological Service (HNMS, n.d.).

Figure 4 Average temperature per month



(HNMS, n.d.)

July is the warmest month of the year. The temperature in July averages 26.5 °C. January has the lowest average temperature of the year. It is 5.2 °C.

Table 4 Thessaloniki Weather by Month – Weather Averages

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	5.2	6.8	9.7	14.5	19.4	23.8	26.5	26.2	22.2	16.9	12	7.3
Min. Temperature (°C)	1.5	2.3	5	9.2	13.8	18	20.5	20.3	16.7	12.2	8.2	3.6
Max. Temperature (°C)	9	11.4	14.4	19.8	25	29.6	32.5	32.1	27.8	21.7	15.8	11.1
Avg. Temperature (°F)	41.4	44.2	49.5	58.1	66.9	74.8	79.7	79.2	72.0	62.4	53.6	45.1
Min. Temperature (°F)	34.7	36.1	41.0	48.6	56.8	64.4	68.9	68.5	62.1	54.0	46.8	38.5
Max. Temperature (°F)	48.2	52.5	57.9	67.6	77.0	85.3	90.5	89.8	82.0	71.1	60.4	52.0
Precipitation / Rainfall (mm)	37	37	43	33	45	31	26	21	27	39	54	52

(climate-data, n.d.)

There is a difference of 33 mm of precipitation between the driest and wettest months. During the year, the average temperatures vary by 21.3 °C.

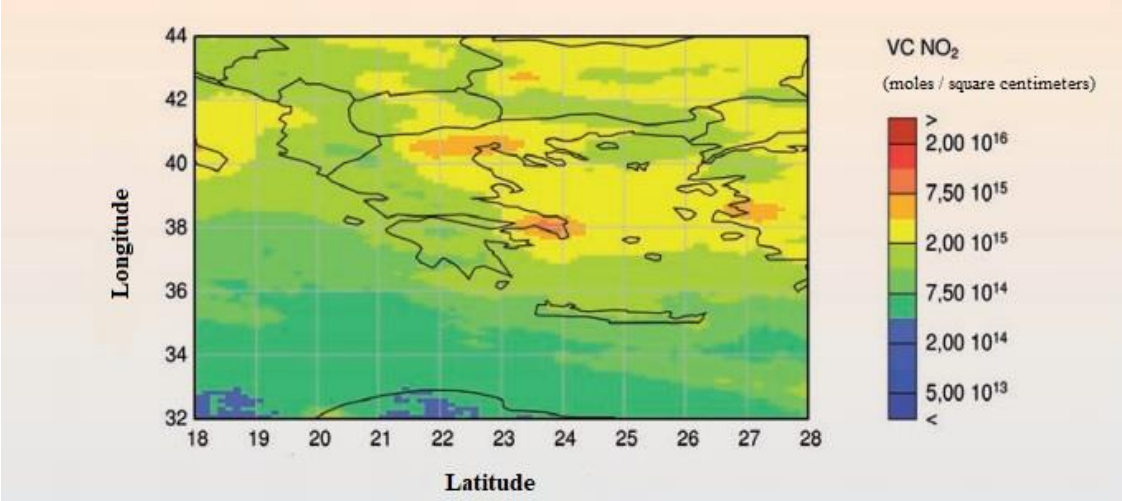
2.4 Environmental Risks in the area of Thessaloniki

Air pollution

Thessaloniki has a low air quality especially in the western suburbs due to the industrial activities and the big use of automobiles in the center of the city. Furthermore, a significant factor during the winter months is the use of organic material for domestic heating. According to the study of identification of emission sources in the area of Thessaloniki (TRAP Del. 3.1) the economic crisis was the major reason for the additional use of organic material for domestic heating. Meteorological factors play a significant role in the whole problem. Other factors that act with a negative way are the transportation (port and airport), the agricultural activities, the mineral dust, the sea salts, the dust from Sahara, the oil combustion for central heating, the photochemical activities, the soil dust resuspension, the construction activities, the neighbor regions and countries lignite-burning power stations for energy production plants (trans-boundary air pollution).

The emissions of NOx are emitted by the production of energy (burning of carbon and lignite) contributing a 59%. Other sources of NOx emissions are the road transportation (29%), and other kinds of transportation (11%). In the next diagram it is obvious that the maximum values of NOx concentration are in the area of Athens and in the Central Makedonia (Thessaloniki / Ptolemaida) through the Greek territory.

Map 5 Emissions of NO_2



(Bank of Greece, 2011)

Short exposure to concentrations below 3 ppm may cause lung irritation, while concentrations above 3 ppm may lead to pulmonary dysfunction. Similarly, long exposure to low concentrations can affect the lung tissue, causing emphysema (Bank of Greece, 2011).

Climate change impact in the area of Thessaloniki

The increase of sea level, due to the melting of ice, it will create problems to the coastline areas. Thessaloniki is considered as one of the big cities in Greece that will face this problem. In a study from AUTH are investigated the negative impacts from 4 different scenarios (increase of sea level by 30, 60, 90 and 120 cm) in the coast-line area of Thessaloniki. These scenarios are based on the IPCC Report regarding the analysis of climate change impact and to the Report of Bank of Greece. In the case of the first scenario (sea level increase by 30 cm), the map below presents the areas of Thessaloniki that will be flooded (Ταμιάκης, 2017).

Map 6 Future flooded areas by a 30 cm sea level increase, in the area of Thessaloniki

(Ταμιάκης, 2017)

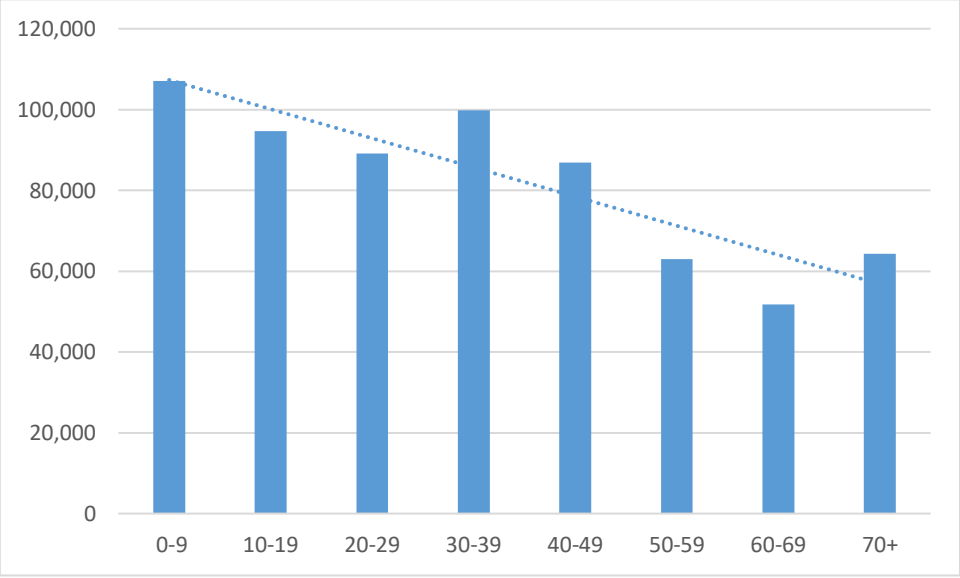
3. DEMOGRAPHY

In 2016, the region accounted for 13.7% (€23.9bn) of the national Gross Domestic Product (GDP), second only to Attiki (€83.5bn), and quite above that of the region of Thessalia (€9.0bn) (Eurostat, 2018). Regional GDP values have been falling since 2008, although in later years (2014-2016) the negative trend has slowed down. Despite that, in terms of GDP per capita in purchasing power standards (PPS), 15,400 in 2016, the region was positioned only eighth among the 13 Greek regions, standing at 52.7% of the EU-28 average (29,200) (European Commision, 2018).

Age distribution

Two age groups are identified by the diagram of the population of the regional unit of Thessaloniki. Based on the population, the first group seems to be from the age of 0 to 49. The second group is identified by the age of 50 to 70+. The trend of the graph shows that population is reducing as the age is getting older.

Figure 5 Age distribution of the population of the Regional Unit of Thessaloniki

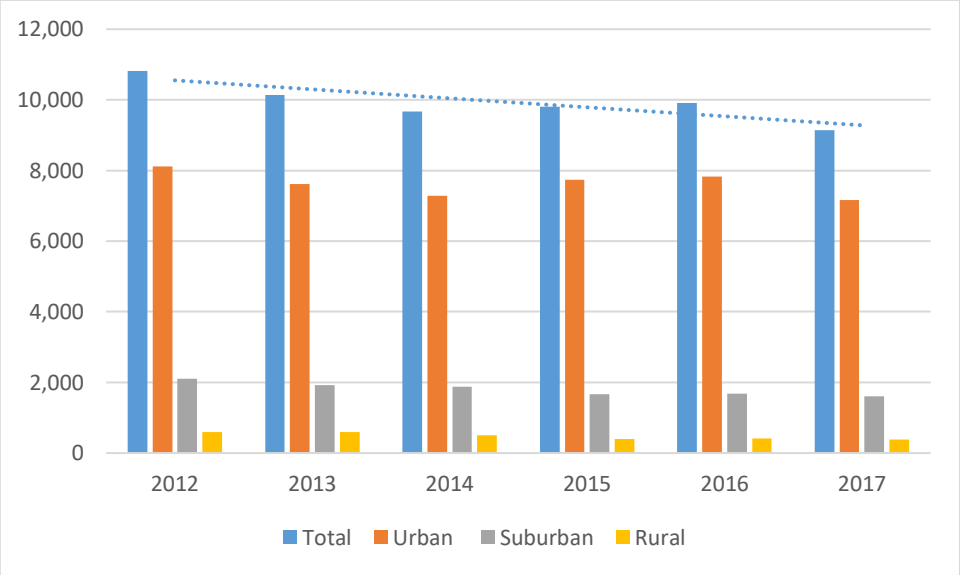


Based on HELLENIC STATISTICAL AUTHORITY Data (2011*)

*Latest Census

Births

Figure 6 Number of births in Thessaloniki's Regional Unit (2012-2017)



Data based on Hellenic Statistic Authority

In the above diagram the numbers of births are presented from 2012 to 2017, in the Regional Unit of Thessaloniki. According to the trend, the number of births seems to be reducing from 10,815 of 2012 to 9,145 of 2017. This pattern is the same also for the urban, the suburban and the rural areas of Regional Unit of Thessaloniki.

In the rural areas births have a considerable reducing rate, while deaths have the same rate during these years for the same areas.

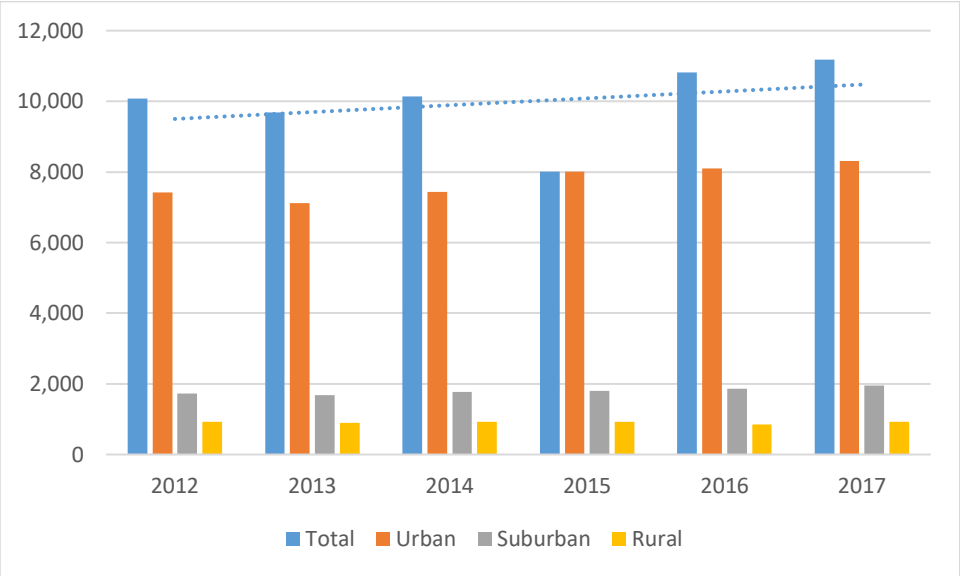
Map 7 Births in Thessaloniki Regional Unit

	2012	2013	2014	2015	2016	2017
Total	10,815	10,144	9,676	9,799	9,919	9,145
Urban	8,119	7,620	7,289	7,733	7,824	7,164
Suburban	2,109	1,926	1,876	1,661	1,676	1,599
Rural	587	598	511	405	419	382

Data based on Hellenic Statistic Authority

Deaths

Figure 7 Number of deaths in Thessaloniki's Regional Unit (2012-2017)



Total deaths in the Regional Unit of Thessaloniki have an increasing rate from 2012 to 2017. The rate in the suburban areas is the bigger one (13,2%), in the urban areas the rate is 11,8%, while the number of deaths in the rural areas remains in the same level.

Vital Index

Table 5 Vital index in the Regional Unit of Thessaloniki

	2012	2013	2014	2015	2016	2017
Total	107	105	95	122	92	82
Urban	109	107	98	97	97	86
Suburban	122	115	106	92	90	82
Rural	63	67	55	44	49	41

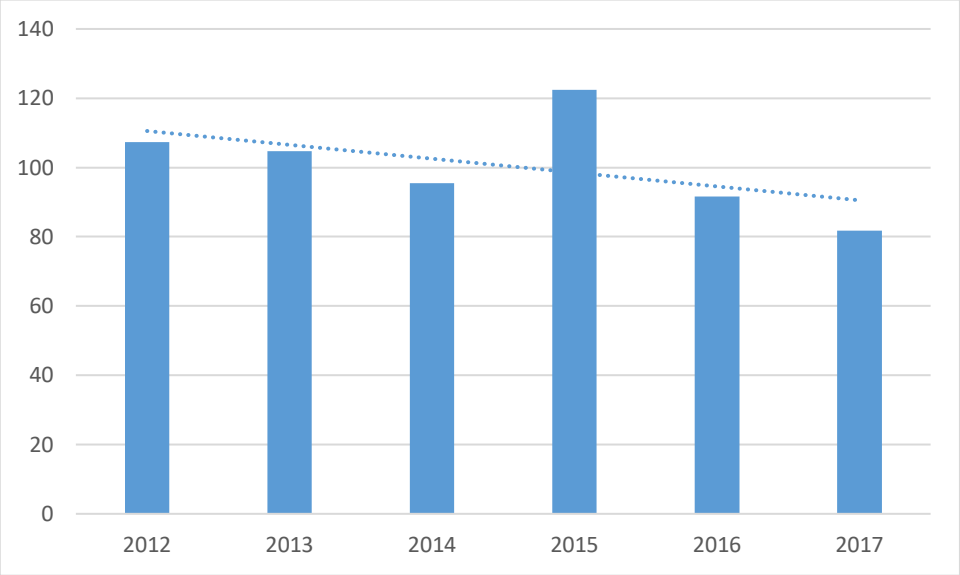
Based on Hellenic Statistic Authority data

Vital Index (VI) is the ratio of live births to deaths within a population during a given time. It shows how many live births are born per 100 deaths. The larger is the *VI*, the greater is population. Vital Index is a direct measure of survival value. If *VI* is greater than 100, the population is not only surviving but growing.

https://www.jstor.org/stable/84531?seq=1#metadata_info_tab_contents

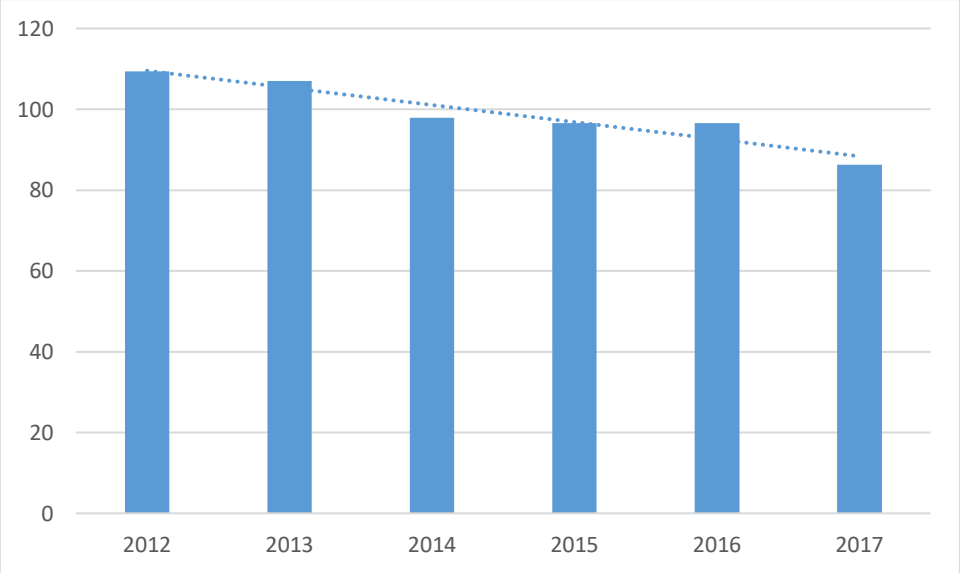
Total population's Vital Index in the Regional Unit of Thessaloniki showcases a trendline that has a decrease rate with an exception on 2015.

Figure 8 Total population's Vital Index of Regional Unit of Thessaloniki



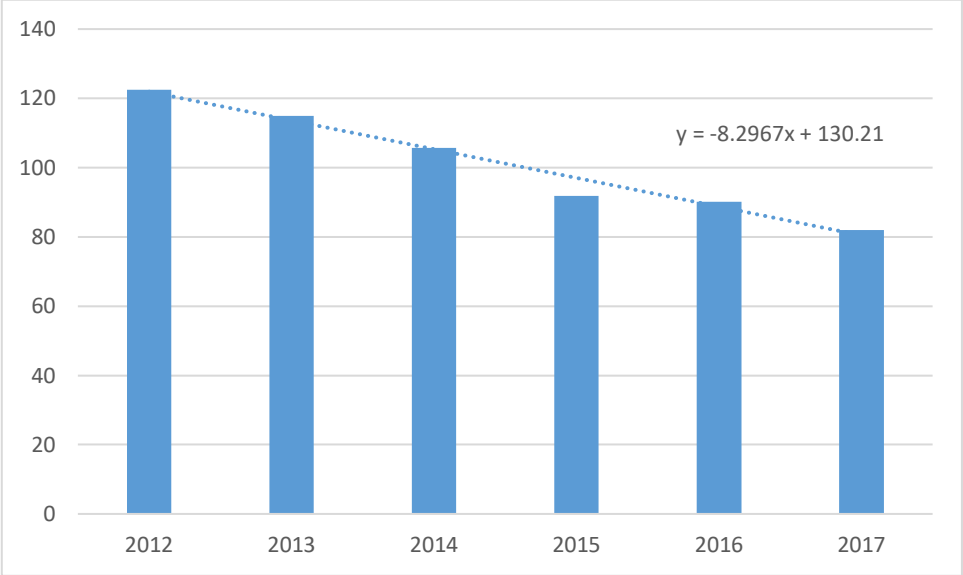
Based on Hellenic Statistic Authority data

Figure 9 Urban population's Vital Index of Regional Unit of Thessaloniki



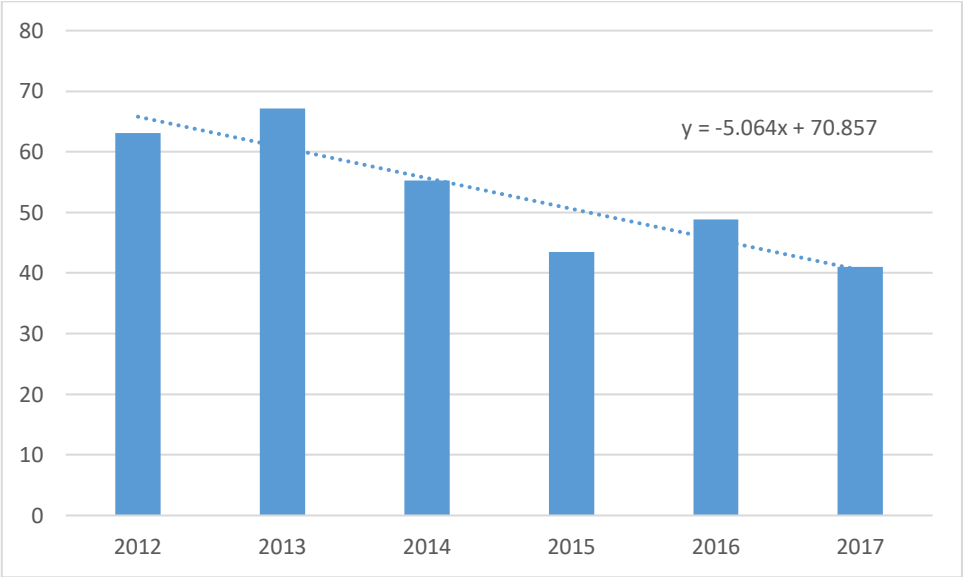
Based on Hellenic Statistic Authority data

Figure 10 Suburban population's Vital Index of Regional Unit of Thessaloniki



Based on Hellenic Statistic Authority data

Figure 11 Rural population's Vital Index of Regional Unit of Thessaloniki



Based on Hellenic Statistic Authority data

Life expectancy in Central Macedonia

According to Eurostat (2018), total population's life expectancy is 81.4 for the year 2017 in the Region of Central Macedonia. Life expectancy minimum value is 81.0 years (2015) and maximum value is 81.4 (2017). Generally, life expectancy for the total population is considered

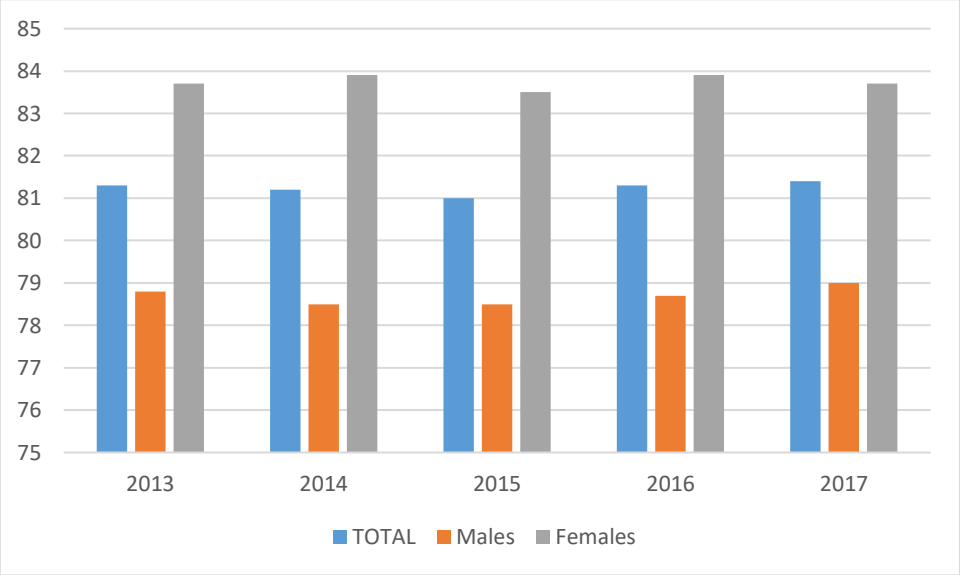
stable. Males have a lower life expectancy than females. In 2017, male's life expectancy was 79.0 years while females' life expectancy was 83.7 years.

Table 6 Life expectancy for different years in the Central Macedonia (EL52).

Central Macedonia	2013	2014	2015	2016	2017
TOTAL	81.3	81.2	81.0	81.3	81.4
Males	78.8	78.5	78.5	78.7	79.0
Females	83.7	83.9	83.5	83.9	83.7

(Eurostat, 2018)

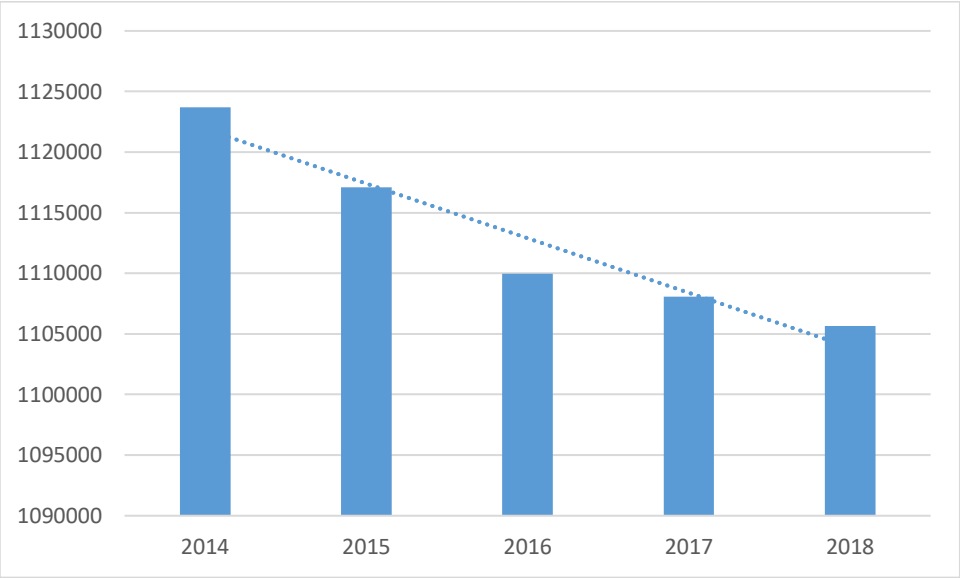
Figure 12 Life expectancy in Central Macedonia (2013-2017)



Based on Eurostat Data

Population change

Figure 13 Population change - Demographic balance and crude rates at the Regional Unit of Thessaloniki (EL522)



Source: Based on Eurostat Data

Households

In the Regional Unit of Central Macedonia, the total number of houses is 587,927. Most of them (73,9%) has a central heating system, while a 20% of them has another kind of heating. Only the 6,1% has not a heating system (Census, 2011).

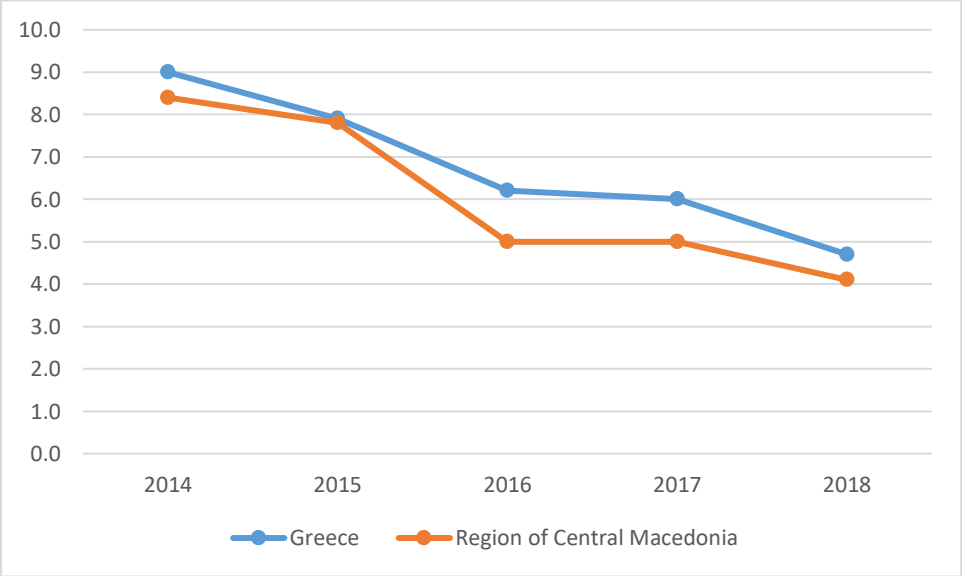
4. SOCIOECONOMIC INDICATORS

4.1 Equal opportunities and access to the labour market

Early leavers from education and training from 18 to 24 years (males and females)

In the Region of Central Macedonia the percentage of early leavers from education and training is lowest than the average of Greece with an exception of 2015 which was in an equal level (8%).

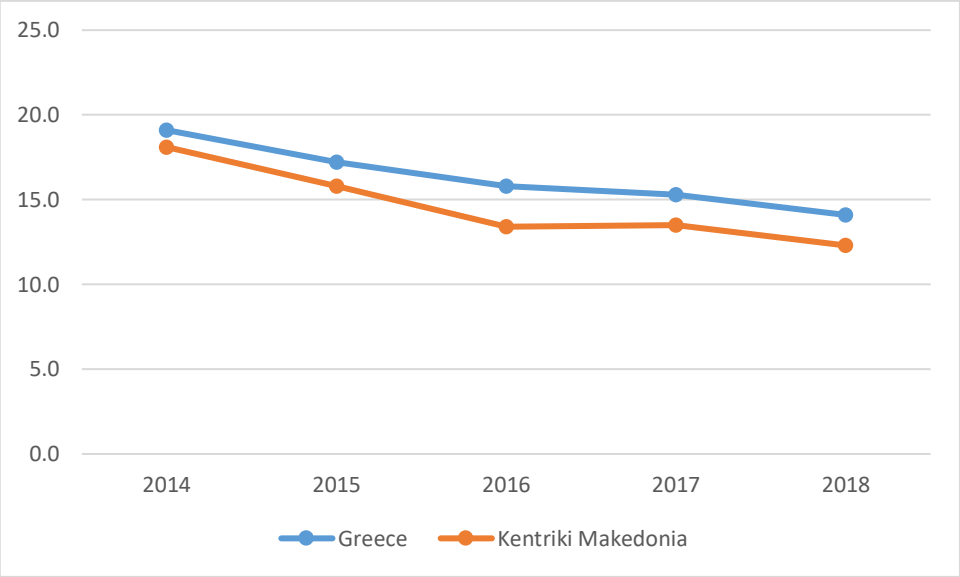
Figure 14 Percentage of early leavers from education and training in the Region of Central Macedonia



Data based on Eurostat

Young people neither in employment nor in education and training (males and females) in the Region of Central Macedonia were in a lower level rate in contrast with the average level rate of average of Greece.

Figure 15 Young people neither in employment nor in education and training from 15 to 24 years in the Region of Central Macedonia



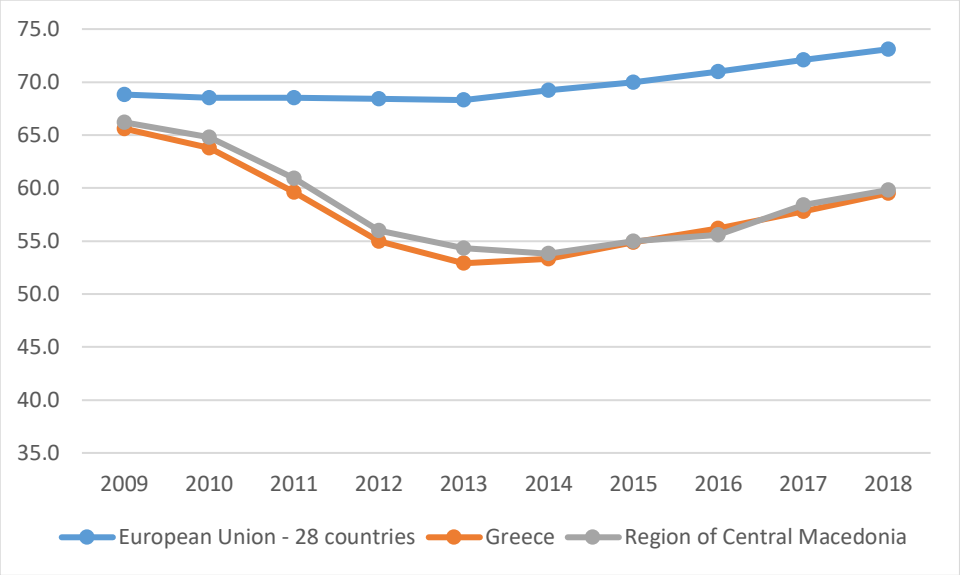
Data based on Eurostat

4.2 Dynamic labour markets and fair working conditions

Employment rates

In the next diagram the employment rates (percentage) are presented from 2009 to 2018. The Region of Central Macedonia has a same trendline pattern with the average of Greece while the difference with EU approaches a maximum of 15.4% in the years 2014 and 2016 while the minimum rate was on 2009 with a percentage of 2.6%. The latest reference on 2018 was a difference of 13.3%. The age class is referred from 20 to 64 years old citizens and males and females are both included.

Figure 16 Employment rates % (males and females) from 2009 to 2018



Data based on Eurostat

4.3 Well-being of society

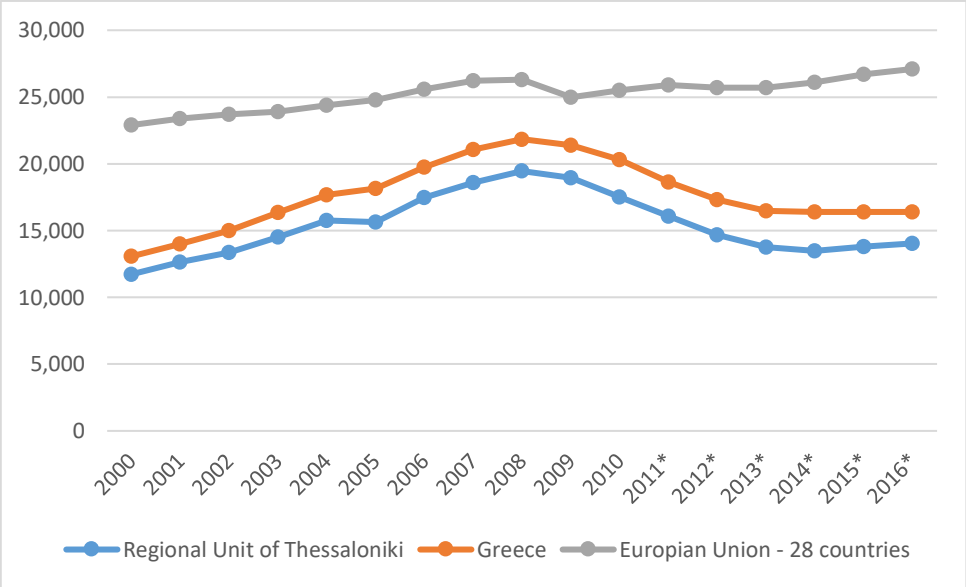
GDP per capita is a measure of a country's economic output that accounts for its number of people. It divides the country's gross domestic product by its total population. That makes it the best measurement of a country's standard of living.

Table 7 GDP per capita (euros)

Year	Regional Unit of Thessaloniki	Greece	EU (28 countries)
2000	11,727	13,071	22,900
2001	12,646	14,011	23,400
2002	13,352	14,994	23,700
2003	14,536	16,371	23,900
2004	15,752	17,683	24,400
2005	15,634	18,134	24,800
2006	17,466	19,769	25,600
2007	18,606	21,061	26,200
2008	19,454	21,845	26,300
2009	18,943	21,386	25,000
2010	17,504	20,324	25,500
2011*	16,094	18,643	25,900
2012*	14,669	17,311	25,700
2013*	13,747	16,475	25,700
2014*	13,494	16,402	26,100
2015*	13,788	16,381	26,700
2016*	14,023	16,378	27,100

In the next diagram the gross domestic product per capita is presented for the Regional Unit of Thessaloniki, Greece and EU (28 countries), during 2000-2016. It is obvious that the average GDP per capita of EU is always more than Greece during these years. Regional Unit of Thessaloniki has a lower GDP per capita than Greece average. The maximum per capita GPD difference between the Regional Unit of Thessaloniki and Greece average was on 2014 with a real amount of 2,908 euros while the minimum difference was on 2000 with a real amount of 1,344 euros. Generally, the difference between R.U. of Thessaloniki and Greece average has an increasing rate during these years, showcasing that Thessaloniki has been affected more by the Greek crisis than other Regional Units in Greece.

Figure 17 - Per capita GDP



Based on Hellenic Statistic Authority and Eurostat Data

*Provisional data (Greece Data).

Note: The estimated population on the 30/6 of each year was used, calculated on the basis of the 2011 population census – regarding Greece data.

GDP per capita is an important indicator of economic performance and a useful unit to make cross-country comparisons of average living standards and economic wellbeing. However, GDP per capita is not a measure of personal income and using it for cross-country comparisons also has some known weaknesses.

5. MORBIDITY

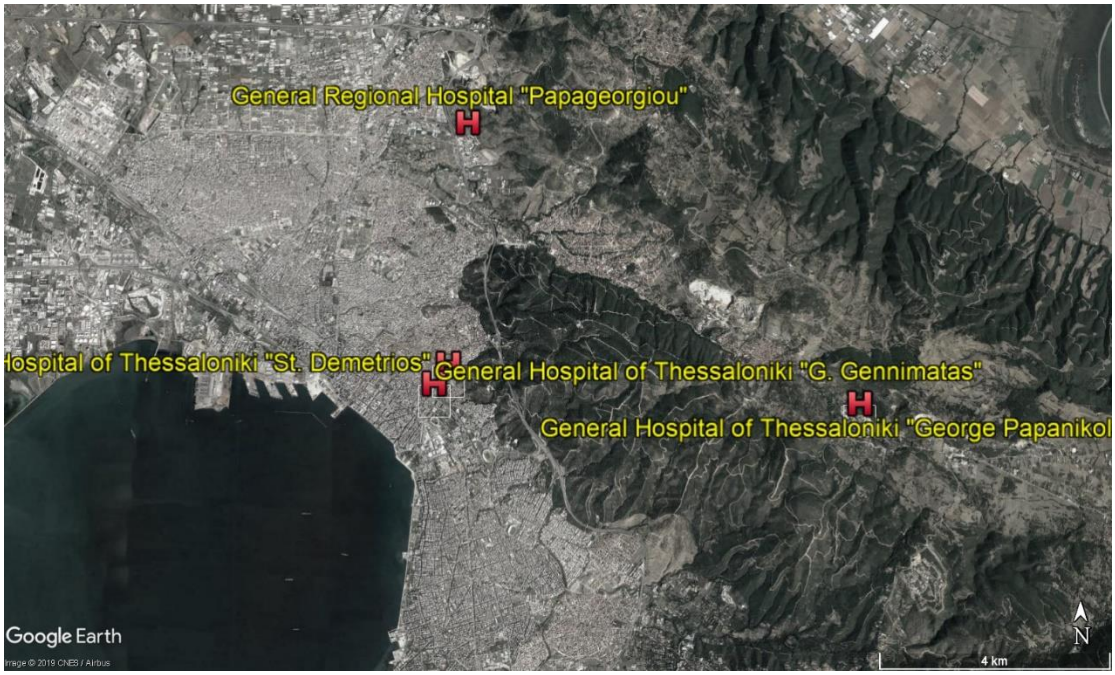
In the following table, hospital data are presented regarding four (4) major hospitals in the area of Thessaloniki (included Papanikolaou Hospital, Papageorgiou Hospital, Gennimatas Hospital and Agios Dimitrios Hospital). The 3rd Health Region of Greece provide the following data for the year 2012. The characteristics that are presented are: the number of beds, the number of patients being hospitalized, the days of hospitalization, the coverage rate, the average duration of hospitalization, the total patients that were examined, the total number of health exams that were provided to the patients during 2012 and the total number of surgical procedures that took place.

Table 8 Hospital patients' incomes in Thessaloniki (2012)

Hospitals	**" Papageorgiou "**	**" Papanikolaou "**	**" Gennimatas "**	**" Agios Dimitrios "**	**Total**
Beds	691	732	279	150	1852
Patients being hospitalized	59736	53186	12536	13203	138661
Days of hospitalization	211938	161669	52221	31933	457761
Coverage rate	84.03	60.51	51.37	58.33	63.56
Average duration of hospitalization	3.55	3.04	4.17	2.42	13.18
Total Patients Examined	295149	169048	96818	85269	646284
Health exams	3006249	2663728	803599	609749	7083325
Surgical procedures	18119	10057	4247	5937	38360

(3YPE, 2012)

Map 8 Spatial Distribution of Hospitals in Thessaloniki



Based on Google Earth

Table 9 Hospital patients' outcomes and type of disease in the Regional Unit of Thessaloniki (2013)

Chapter Code	**Description**	**Patients Discharges**
Total		**153,865**
II C00-D48	Neoplasms	21,093
IX I00-I99	Diseases of the circulatory system	20,285
XI K00-K93	Diseases of the digestive system	15,004
XV O00-O99	Pregnancy, childbirth and the puerperium	12,641
XVIII R00-R99	Symptoms, signs and abnormal clinical and laboratory findings	12,482
XIV N00-N99	Diseases of the genitourinary system	11,937

XIX S00-T98	Injury, poisoning and certain other consequences of external causes	11,277
X J00-J99	Diseases of the respiratory system	9,894
VI G00-G99	Diseases of the nervous system	6,086
VII H00-H59	Diseases of the eye, adnexa	5,823
XIII M00-M99	Diseases of the musculoskeletal system and connective tissue	5,502
V F00-F99	Mental and behavioural disorders	4,608
IV E00-E90	Endocrine, nutritional and metabolic diseases	3,649
I A00-B99	Certain infectious and parasitic diseases	2,801
III D50-D89	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	2,321
XXI Z00-Z99	Factors influencing health status and contact with health services	2,174
XX V01-Y98	External causes of morbidity and mortality	1,634
XVI P00-P96	Certain conditions originating in the perinatal period	1,620
XII L00-L99	Diseases of the skin and subcutaneous tissue	1,423
XVII Q00-Q99	Congenital malformations, deformations and chromosomal abnormalities	847
VIII H60-H95	Diseases of the ear and mastoid process	764

Based on Eurostat Data

Hospitals Data

In the next pages, the data that are presented are referred to each hospital separately and the sources are the annual reports of each hospital. Annually data are provided for the years 2016, 2017 and 2018 are provided for Hippocrates hospital, Papageoergiou hospital, Gennimatas Hospital and Agios Dimitras Hospital. Annually data for the years 2015, 2016 and 2017 are provided from “Agios Pavlos” hospital. “Papanikolaou” hospital provides data from 2016 to 2017. Finally, AHEPA hospital provides data only for the years 2010 and 2011.

“Hippocrates” Hospital

Thessaloniki General Hospital "Hippocrates" is one of the largest hospitals in Greece and in the Balkans. It came from the merger of the former "Hagia Sophia" and "Hippocrates" hospitals. It is a member of the National Health Service of Macedonia and is under the supervision of the 4th Health Region of Macedonia and Thrace and is affiliated with the Thessaloniki Aphrodisias and Diseases Hospital. It provides primary, secondary and tertiary care on an equal footing to every citizen, regardless of their economic, social and occupational status.

Table 10 “Hippocrates” Hospital Data

	2016	**2017**	**2018**
Beds	801	811	832
Patients being hospitalized	41941	42618	42955
Average duration of hospitalization	4.15	4.08	3.99
Total Patients Examined	303149	296813	313658
Surgical procedures	16113	17404	17994

(Ipokratio Hospital, 2019)

In 2018, “Hippocrates” hospital had 42955 patients being hospitalized, 337 more than 2017 and 1014 more than 2016. In 2018, “Hippocrates” had an average duration of hospitalization 3.99 days per patient, the total patients that examined were 313658 and the surgical procedures were 17994.

Hippocrates Hospital

Papageorgiou Hospital

Papageorgiou Hospital is a Legal Entity of Private Law, Non-Profit, Offers Prevention, Diagnosis, Treatment and Rehabilitation Services and operates since 1999. It is fully integrated in the National Health System and on call according to the on-call schedule of the Thessaloniki Hospitals. The establishment of University Clinics in 2004 completed the Hospital's staffing, which has been in constant collaboration with the School of Medicine of the School of Health Sciences of the Aristotle University of Thessaloniki since 2004.

In 2018, Papageorgiou hospital had 222.617 days of hospitalization, 86,02% coverage, 20.335 surgical procedures, 342.349 out-patients, 80.198 in-patients and 1.679 personnel (553 doctors, 770 nurses, 356 other) (Annual Report, 2018).

Table 11 "Papageorgiou" Hospital Data

Papageorgiou Hospital	**2016**	**2017**	**2018**
Patients being hospitalized	71.367	74.803	80.198
Days of hospitalization	221.174	223.055	222.617
Coverage rate	-	-	-
Average duration of hospitalization	3.10	2.98	2.78
Total Patients Examined	317.706	325.995	342.349
Surgical procedures	19.978	19.769	20.355

(Papageorgiou Hospital, 2018)

Papageorgiou Hospital

Papanikolaou Hospital

The General Hospital of Thessaloniki "C. PAPANIKOLAOU" is a tertiary hospital with departments of all medical specialties (except gynecology, pediatrics and urology) and is staffed with well-qualified medical, nursing, paramedical, technical and administrative staff and by their contribution is provided high quality human health care with responsibility.

In 2017, Papanikolaou Hospital had 50.446 patients being hospitalized, 10.809 surgical procedures, 187.345 out-patients (115.626 in medical offices and 68.719 emergencies). Also, Papanikolaou hospital had 622 beds and 1376 personnel in 2018 (Annual Report, 2018).

Table 12 "Papanikolaou" Hospital Data

Papanikolaou Hospital	**2016**	**2017**
Patients being hospitalized	50236	50446
Days of hospitalization	164091	162372
Coverage rate	72.28	71.52
Average duration of hospitalization	3.27	3.22
Total Patients Examined	172.317	187.345
Surgical procedures	10.791	10.809

(Papanikolaou Hospital, 2017)

Papanikolaou Hospital

"Gennimatas" and "Ag. Dimitrios" Hospitals

"Gennimatas" Hospital and "Agios Dimitrios" Hospital are two interconnected hospitals with a specific framework for cooperation at the administrative, nursing and medical level. The two hospitals have:

- Cooperation in the coverage of operational needs.
- Common administrative and financial management
- Common working groups
- Educational and scientific cooperation

"Gennimatas" Hospital

"Genimatas" Hospital, located in the center of the city, has been providing health care services for over a hundred years. The major target of the hospital is to Provide Primary and Secondary Health Care to the Responsible Population of the 3rd Command In Macedonia, as well as in patients referred by other Ministries of Health, every citizen is provided with equal rights regardless of his / her economic, social and occupational status, in accordance with the rules of the National Health and Social Security System.

Table 13 "Gennimatas" Hospital Data

	2016	2017	2018
Patients being hospitalized	14.454	15.913	16.458
Days of hospitalization	44.286	46.151	46.579
Coverage rate	43.37	45.32	45.74
Average duration of hospitalization	3.06	2.92	2.83
Total Patients Examined	101899	97803	102199
Surgical procedures	4082	4394	4736

(Gennimatas Hospital, 2018)

In 2018, "Gennimatas" hospital had 16458 patients in hospitalization, 46579 days of hospitalization, 45,7% coverage, 2,38 average days of hospitalization, 102199 patients that were examined and 4736 surgical procedures.

"Agios Dimitrios" Hospital

Built between 1900 and 1903, its name was initially Hospital of Poor Foreign. After 1912 it became property of the Municipality of Thessaloniki and functioned as a Municipal Hospital. In 1971 it was granted to the Greek State and renamed to "Agios Dimitrios".

Table 14 "Agios Dimitrios" Hospital Data

	2016	2017	2018
Patients being hospitalized	13196	14663	16647
Days of hospitalization	30219	31468	33919
Coverage rate	54.83	57.1	58.89
Average duration of hospitalization	2.29	2.15	2.24
Total Patients Examined	75093	76910	84150
Surgical procedures	5608	5995	6911

(Agios Dimitrios Hospital, 2018)

In 2018, “Agios Dimitrios” hospital had 16647 patients that were hospitalized, the days of hospitalization were 33919, the average duration of hospitalization was 2.24 days, the totals patients that were examined were 84150 and the surgical procedures were 6911.

AHEPA Hospital

The AHEPA Univesrity General Hospital of Thessaloniki is considered one of the biggest hospitals in Greece. Covers 680 beds and all the spectrum of medical and surgical specialties of medicine as well as the psychiatric sector.

It is a State Hospital associated with the 4th Health District of Health Services of Macedonia and Thrace as an independent service, with administrative and economic autonomy. The central service of AHEPA hospital is located in the territory of Aristotle University of Thessaloniki.

Table 15 AHEPA Hospital Data

	2010	**2011**
Patients being hospitalized	52223	48748
Days of hospitalization	163814	159022
Average duration of hospitalization	3.12	3.26
Total Patients Examined	167503	162524
Surgical procedures	8279	7789
Coverage	67.69	67.34

(AHEPA Hospital, n.d.)

In 2011, “AHEPA” hospital had 48748 patients that were hospitalized, 159022 days of hospitalization, 3.26 average duration of hospitalization, 162524 patients that were examined and 7789 surgical procedures while the coverage was 67,34%.

AHEPA Hospital

“Agios Pavlos” Hospital

Agios Pavlos Hospital belongs to the 4th Health District of Macedonia & Thrace. The Hospital is the only public hospital serving the eastern part of Thessaloniki and includes the Municipalities of Kalamaria, Pylea-Chortiatis, Thermis and Thermaikos. It is also important that due to the geographical location of the Hospital it is the closest to Halkidiki and thus it deals with many tourist incidents during the summer months.

Table 16 "Agios Pavlos" Hospital Data

	2015	**2016**	**2017**
Total patients examined	89401	113310	118724
Days of hospitalization	36748	40166	41832
Incomes patients	20390	16768	23139
Patients being hospitalized	21955	18393	24747
Surgical operations	3970	4717	4551
Coverage %	44.75	48.78	50.94

("Agios Pavlos" Hospital, 2018)

During 2017, the total patients that examined were 118724, the days of hospitalizations were 41832, the patients that were being hospitalized were 24747 and the surgical operations were 4551. According to the annual report of the hospital (2018), during 2017, 29323 more patients were examined than 2015 while 581 more surgical operations were done than 2015.

"Agios Pavlos" Hospital

Hospital Data Combination

According to the available data, the following table presents the total patients being hospitalized, the days of hospitalization, the average duration of hospitalization, the total patients being examined and the surgical procedures, regarding the hospitals* of Thessaloniki for the years of 2016 and 2017.

Table 17 Available data of Thessaloniki's Hospitals

	2016	2017	% Difference	Real difference
Patients being hospitalized	209587	223190	6.5 % ↗	13603
Days of hospitalization	673991	678759	0.7 % ↗	4768
Average duration of hospitalization	3.22	3.04	-5.6 % ↷	-0.18
Total Patients Examined	1160355	1034371	-10.9 % ↷	-125984
Surgical procedures	61289	62922	2.7 % ↗	1633

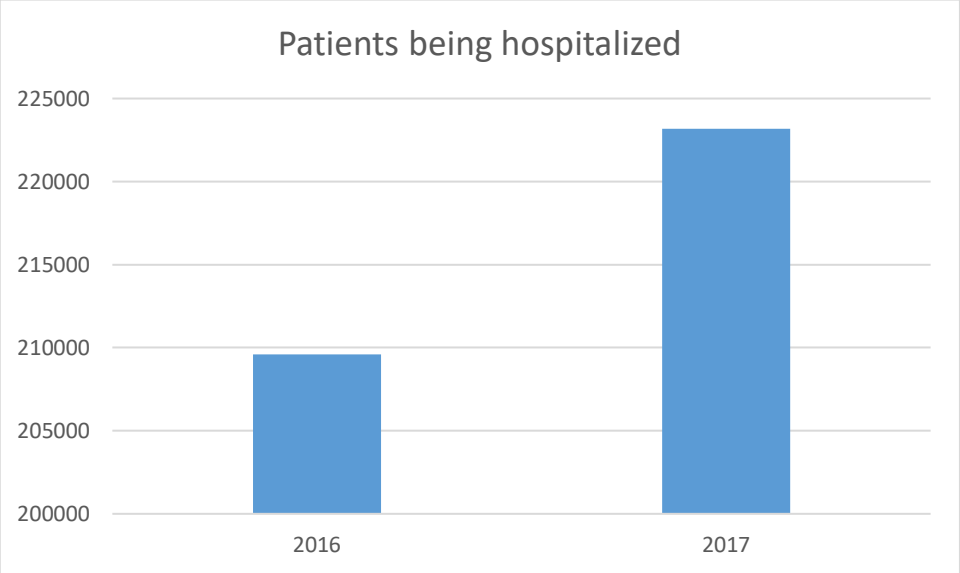
Data based on annual reports of hospitals

*The Hospitals that are included to that chapter analysis are: “Papageorgiou” hospital, “Gennimatas” hospital, “Agios Dimitrios” hospital and “Hippocrates" hospital, due to the same years of data relation.

Analytical graphs

The patients being hospitalized had an increase from 2016 to 2017. The percentage change between 2016 and 2017 was 4.4%. The patients during 2017 were 6572 more than in 2016.

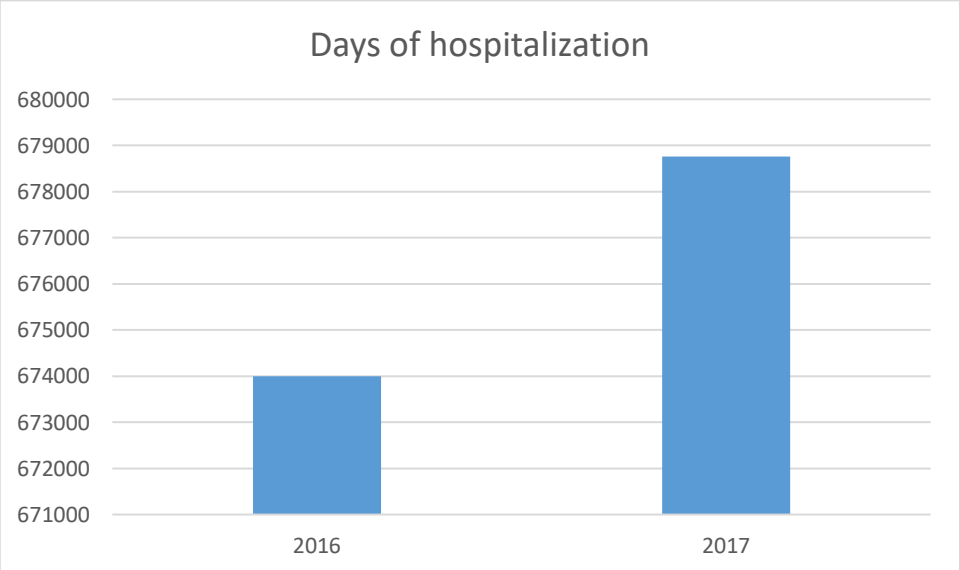
Figure 18 Patients being hospitalized



Data based on annual reports of hospitals

The days of hospitalization had an increase from 2012 to 2016 and from 2016 to 2017. The percentage change between 2016 and 2017 was 0.7%. The hospitalization days during 2017 were 3276 more than in 2016.

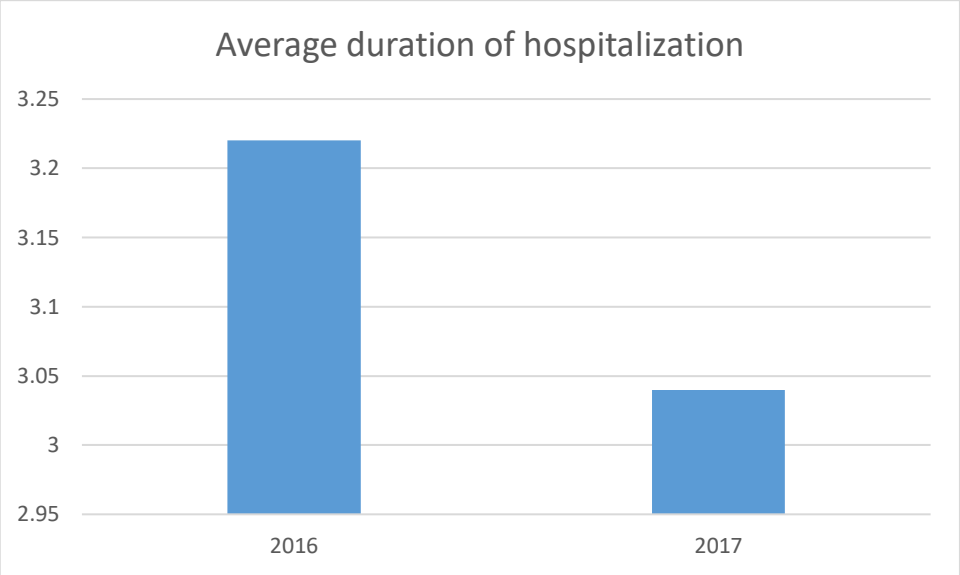
Figure 19 Days of hospitalization



Data based on annual reports of hospitals

The average duration of hospitalization has been reduced during these years (2012-2017). A reason of this pattern could be the increased number of patients that were being hospitalized, and as a result of this pressure, the patients took their discharge note in a shorter duration, in order more patients to be hospitalized.

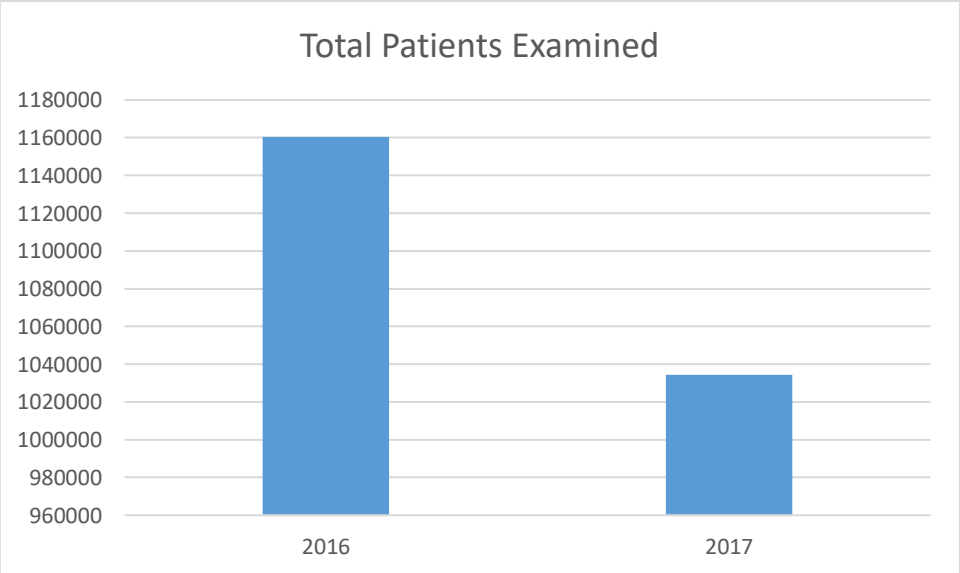
Figure 20 Average duration of hospitalization



Data based on annual reports of hospitals and 3rd Health Region of Greece

The number of total patients examined (emergencies, tactical visits etc) has been increased during these years (2012-2017). The percentage change between 2016 and 2017 is 3.15%, while the percentage change between 2012 and 2017 is 6.5%.

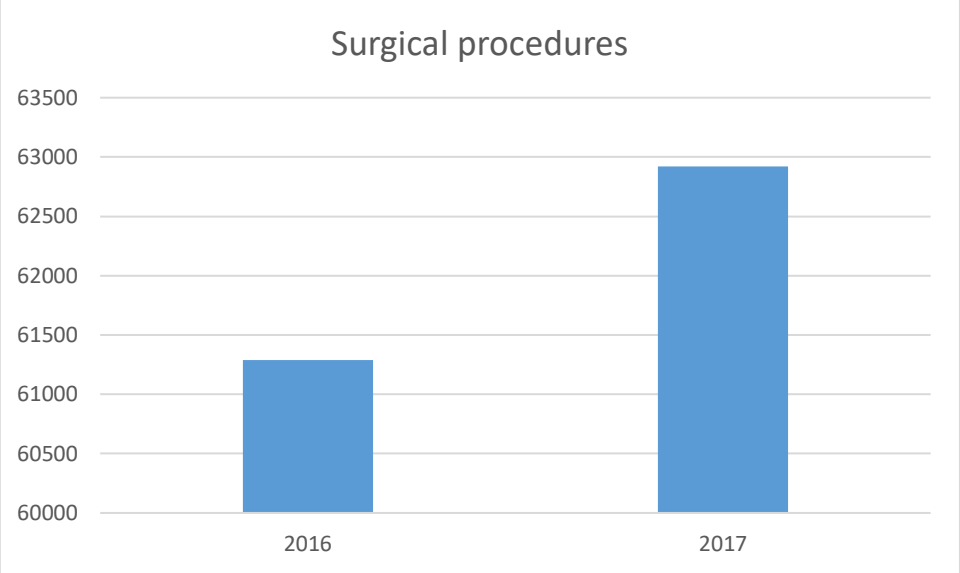
Figure 21 Total Patients Examined



Data based on annual reports of hospitals

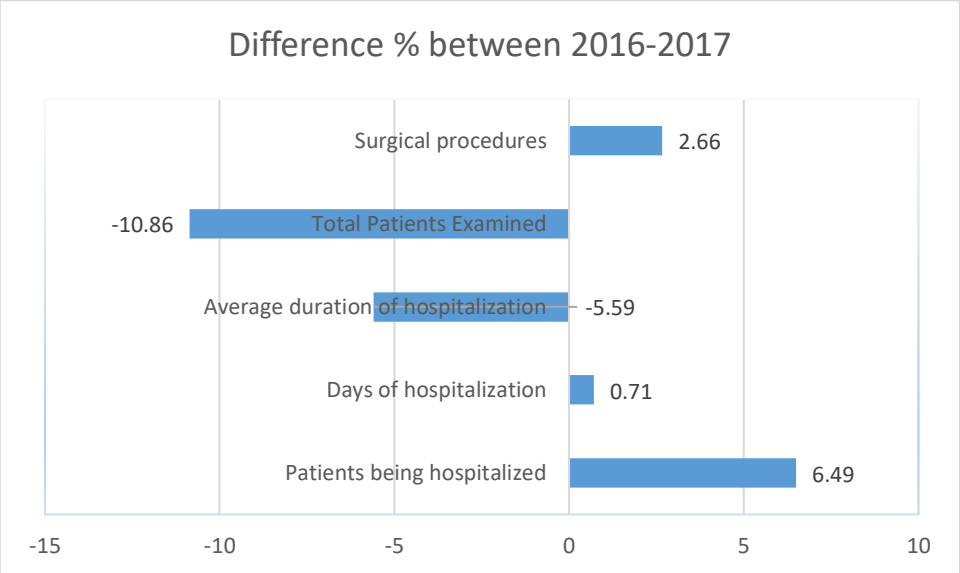
Surgical procedures have a considerable increase between 2012 and 2016, with a percentage change of 5.5%. The total number of surgical procedures for 2017 was 40967.

Figure 22 Surgical procedures



Data based on annual reports of hospitals

Figure 23 Difference % between 2016-2017



Data based on annual reports of hospitals

The general image of these data is that citizens of Thessaloniki and the greater area, have a more considerable need for medical visits in the Hospitals of Thessaloniki. In the previous

datasets, four (4) major hospitals of the Regional Unite of Thessaloniki were identified and analyzed.

6. MORTALITY

6.1 Causes of death

Table 18 Causes of death in the Region of Central Macedonia

Region of Central Macedonia - 2016	**Code**	**Rate**
All causes of death (A00-Y89) excluding S00-T98	A-R_V-Y	1,009.54
Certain infectious and parasitic diseases (A00-B99)	A_B	26.49
Viral hepatitis and sequelae of viral hepatitis	B15-B19_B942	0.92
Tuberculosis	A15-A19_B90	0.44
Other infectious and parasitic diseases (remainder of A00-B99)	A_B_OTH	25.01
Human immunodeficiency virus [HIV] disease	B20-B24	0.12
Neoplasms	C00-D48	265
Malignant neoplasms (C00-C97)	C	260.73
Malignant neoplasm of lip, oral cavity, pharynx	C00-C14	2.65
Malignant neoplasm of oesophagus	C15	1.77

Malignant neoplasm of stomach	C16	15.24
Malignant neoplasm of colon, rectosigmoid junction, rectum, anus and anal canal	C18-C21	25.43
Malignant neoplasm of liver and intrahepatic bile ducts	C22	14.03
Malignant neoplasm of pancreas	C25	15.58
Malignant neoplasm of laryx	C32	3.1
Malignant neoplasm of trachea, bronchus and lung	C33_C34	63.44
Malignant melanoma of skin	C43	2.36
Malignant neoplasm of breast	C50	18.54
Malignant neoplasm of cervix uteri	C53	1.32
Malignant neoplasm of other parts of uterus	C54_C55	3.27
Malignant neoplasm of ovary	C56	5.47
Malignant neoplasm of prostate	C61	15.7
Malignant neoplasm of kidney, except renal pelvis	C64	5.29
Malignant neoplasm of bladder	C67	10.66
Malignant neoplasm of brain and central nervous system	C70-C72	9.51
Malignant neoplasm of thyroid gland	C73	0.95
Hodgkin disease and lymphomas	C81-C86	5.15

Other malignant neoplasm of lymphoid, haematopoietic and related tissue	C88_C90_C96	4.14
Leukaemia	C91-C95	10.02
Other malignant neoplasms (remainder of C00-C97)	C_OTH	27.13
Non-malignant neoplasms (benign and uncertain)	D00-D48	4.17
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	D50-D89	2.44
Endocrine, nutritional and metabolic diseases (E00-E90)	E	19.84
Diabetes mellitus	E10-E14	17.18
Other endocrine, nutritional and metabolic diseases (remainder of E00-E90)	E_OTH	2.66
Mental and behavioural disorders (F00-F99)	F	11.15
Dementia	F01_F03	9.89
Mental and behavioural disorders due to use of alcohol	F10	0.24
Drug dependence, toxicomania (F11-F16, F18-F19)	TOXICO	-
Other mental and behavioural disorders (remainder of F00-F99)	F_OTH	1.02
Diseases of the nervous system and the sense organs (G00-H95)	G_H	24.71
Parkinson disease	G20	9.12
Alzheimer disease	G30	5.05

Other diseases of the nervous system and the sense organs (remainder of G00-H95)	G_H_OTH	10.53
Diseases of the circulatory system (I00-I99)	I	396.31
Ischaemic heart diseases	I20-I25	98.28
Acute myocardial infarction including subsequent myocardial infarction	I21_I22	52.64
Other ischaemic heart diseases	I20_I23-I25	45.64
Other heart diseases	I30-I51	109.93
Cerebrovascular diseases	I60-I69	130.69
Other diseases of the circulatory system (remainder of I00-I99)	I_OTH	57.4
Diseases of the respiratory system (J00-J99)	J	99.52
Influenza (including swine flu)	J09-J11	0.57
Pneumonia	J12-J18	9.91
Chronic lower respiratory diseases	J40-J47	23.72
Asthma and status asthmaticus	J45_J46	0.24
Other lower respiratory diseases	J40-J44_J47	23.48
Other diseases of the respiratory system (remainder of J00-J99)	J_OTH	65.31
Diseases of the digestive system (K00-K93)	K	27.7
Ulcer of stomach, duodenum and jejunum	K25-K28	4.89
Chronic liver disease	K70_K73_K74	6.45

Other diseases of the digestive system (remainder of K00-K93)	K_OTH	16.36
Diseases of the skin and subcutaneous tissue (L00-L99)	L	0.37
Diseases of the musculoskeletal system and connective tissue (M00-M99)	M	2.04
Rheumatoid arthritis and arthrosis (M05-M06, M15-M19)	RHEUM_ARTHRO	0.35
Other diseases of the musculoskeletal system and connective tissue (remainder of M00-M99)	M_OTH	1.69
Diseases of the genitourinary system (N00-N99)	N	31.53
Diseases of kidney and ureter	N00-N29	25.88
Other diseases of the genitourinary system (remainder of N00-N99)	N_OTH	5.66
Pregnancy, childbirth and the puerperium (O00-O99)	O	-
Certain conditions originating in the perinatal period (P00-P96)	P	3.18
Congenital malformations, deformations and chromosomal abnormalities (Q00-Q99)	Q	1.72
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99)	R	65.88
Sudden infant death syndrome	R95	-

Ill-defined and unknown causes of mortality	R96-R99	-
Other symptoms, signs and abnormal clinical and laboratory findings (remainder of R00-R99)	R_OTH	65.83
External causes of morbidity and mortality (V01-Y89)	V01-Y89	31.73
Accidents (V01-X59, Y85, Y86)	ACC	22.02
Transport accidents (V01-V99, Y85)	V_Y85	7.45
Other accidents (W20-W64, W75-X39, X50-X59, Y86)	ACC_OTH	5.88
Falls	W00-W19	4.37
Accidental drowning and submersion	W65-W74	1.74
Intentional self-harm	X60-X84_Y870	4
Accidental poisoning by and exposure to noxious substances	X40-X49	2.58
Assault	X85-Y09_Y871	0.88
Event of undetermined intent	Y10-Y34_Y872	0.2
Other external causes of morbidity and mortality (remainder of V01-Y89)	V01-Y89_OTH	4.63

Source: Based on Eurostat

6.2 Top seven causes of death in the Region of Central Macedonia

Table 19 Top seven causes of death in the Region of Central Macedonia

Cause of Death (2016)	Code	Rate
Diseases of the circulatory system (I00-I99)	I	396.31
Malignant neoplasms (C00-C97)	C	260.73
Diseases of the respiratory system (J00-J99)	J	99.52
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99)	R	65.88
Diseases of the genitourinary system (N00-N99)	N	31.53
Diseases of the digestive system (K00-K93)	K	27.7
Endocrine, nutritional and metabolic diseases (E00-E90)	E	19.84

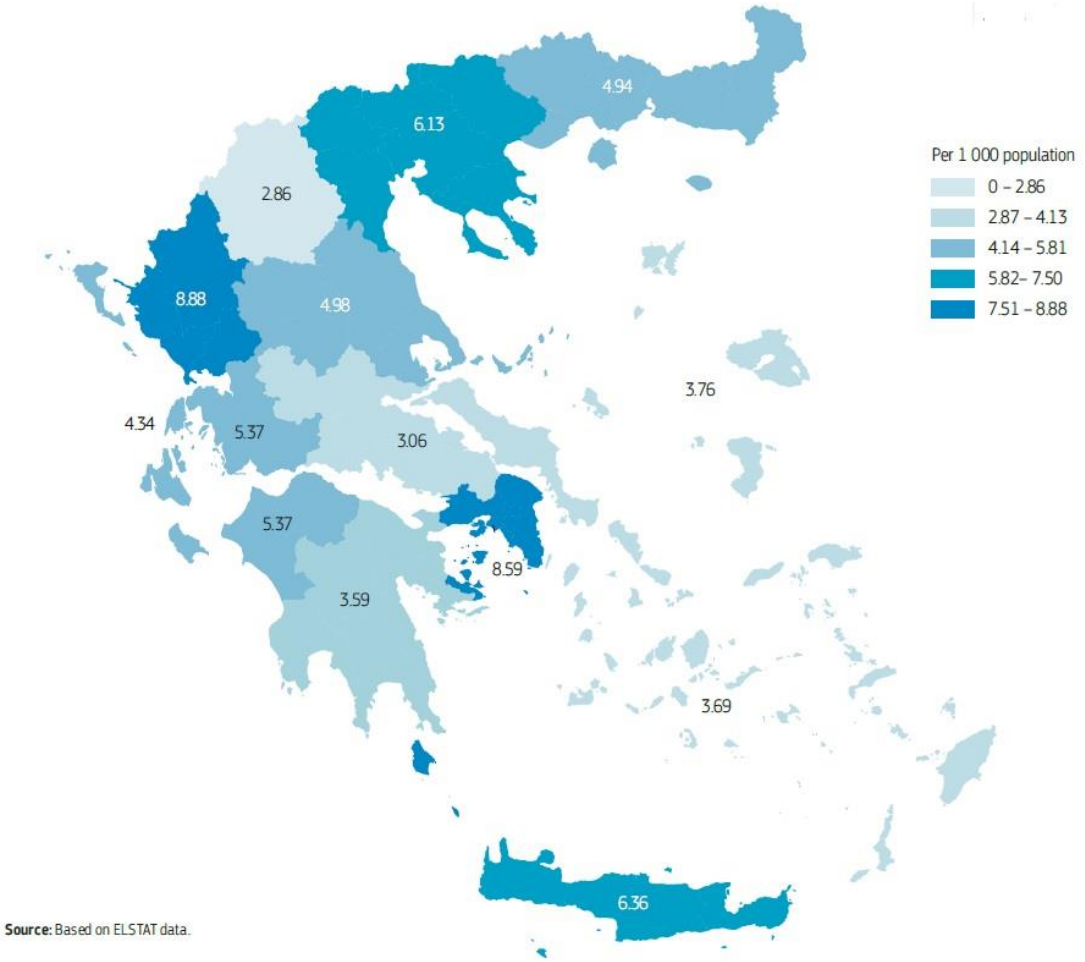
(Eurostast, 2016)

The table above, presents the major groups of diseases that are concerned as the causes of death in the Region of Central Macedonia in 2016. The top five causes of death (Figure 24) in the Region of Central Macedonia (2016) with the respectively rates are: 1) Diseases of the circulatory system (396.31), 2) Malignant neoplasms (260.73), 3) Diseases of the respiratory system (99.52), 4) Symptoms signs and abnormal clinical and laboratory findings (65.88), 5) Diseases of the genitourinary system (31.53), 6) Diseases of the genitourinary system (27.7) and Endocrine, nutritional and metabolic diseases (19.84).

Doctors Distribution

According to Country Health Profile Report of Greece (2017), Physicians' density in 2014 varied from 2.9 per 1 000 population in Western Macedonia and Central Greece to 8.6 per 1000 in Attica (HELLENIC STATISTIC AUTHORITY, 2016). Although some (financial) incentives have been offered for doctors practising in rural parts of Greece, these have not been enough to recruit and retain staff in these areas.

Map 9 The distribution of doctors across Greece

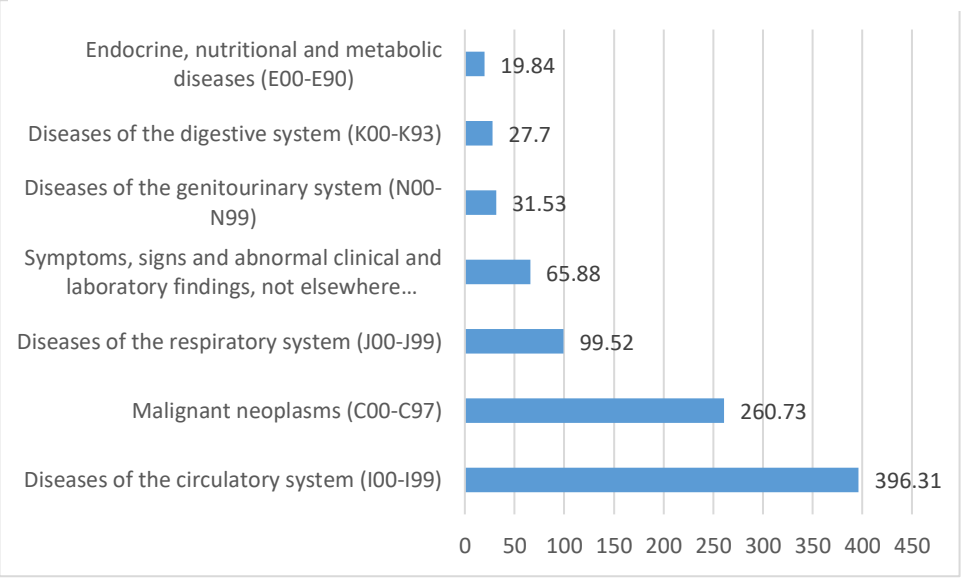


(Country Health Profile of Greece, 2019)

7. Conclusions

- Thessaloniki is the second largest Greek city and has the second largest commercial port. The city is characterized by intense vehicular traffic in the center and several industrial units located in the West, North-West and North.
- The data that were used in this study are the latest publicized in official portals such as the Hellenic Statistical Agency or the Eurostat.
- Thessaloniki is a high transportation hub, with road infrastructure, port and airport.
- The low intense of winds (1-2 bf) has as a result the air above the city not to be transferred and the air pollutants to remain in high levels of concentration.
- During the winter months and especially after the financial crisis, organic material is used for domestic heating, increasing the air pollution levels.
- Regarding the Regional Unit of Thessaloniki, the number of births follow a reducing rate, while the number of deaths have an increasing rate.
- Total population life expectancy is 81.4 years and during the years 2013 – 2017, live expectancy is considered stable for the Region of Central Macedonia.
- The general picture is that hospitals hospitalize more patients during the latest years while the average duration of hospitalization is reducing.
- In addition, the number of the surgical procedures have an increasing rate during the latest years.
- The distribution of doctors across Greece showcases that Region of Central Macedonia has the second place in Greece, with 5.52 to 7.50 doctors per 1000 population.
- During 2013 the hospital patients' outcomes and the type of disease are the following in the Regional Unit of Thessaloniki: 1) Neoplasms, 2) Diseases of the circulatory system, 3) Pregnancy, childbirth and the puerperium, 4) Symptoms, signs and abnormal clinical and laboratory findings, 5) Diseases of the genitourinary system.
- The top five causes of death (Figure 24) in the Region of Central Macedonia (2016) with the respectively rates are: 1) Diseases of the circulatory system (396.31), 2) Malignant neoplasms (260.73), 3) Diseases of the respiratory system (99.52), 4) Symptoms signs and abnormal clinical and laboratory findings (65.88), 5) Diseases of the genitourinary system (31.53), 6) Diseases of the genitourinary system (27.7) and Endocrine, nutritional and metabolic diseases (19.84).

Figure 24 Causes of Death (2016)



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