The synergistic effect of ambient heat and air pollution exposure on mortality in Athens, Thessaloniki and Volos, Greece

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INTRODUCTION

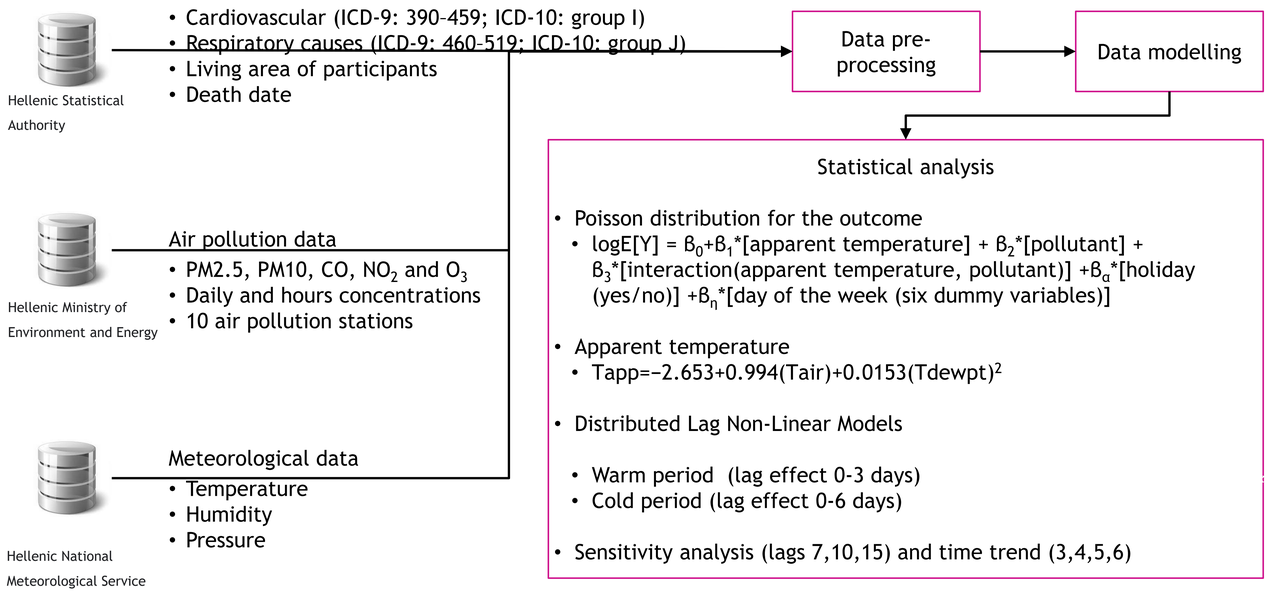
Meteorological variability plays a significant role in the air pollution spread and levels and it can have significant effect on human health. Prolonged and frequent high-temperature waves in combination with high average temperatures have been associated with higher mortality levels, which is due to the thermal stress and the reactions of human compensatory mechanisms.

Also, air pollution is a well-known public health risk factor. In the past 3 decades many epidemiologic studies have given evidence for a positive association between air pollutants concentrations and total and cause-specific mortality.

AIM

This study aims to examine the synergistic effect of weather conditions and air pollution on human mortality.

METHODOLOGY



Study period

- From 1/1/2010 to 31/12/2019

Figure 1 Map of Greece and study areas

RESULTS

Figure 2. Daily number of cardiovascular and respiratory causes deaths in Attica (ATT), Magnesia (MAG) and Thessaloniki (THE)

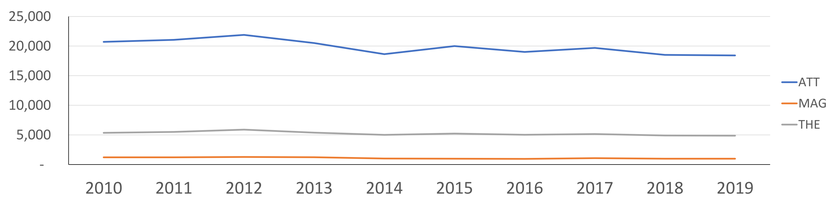


Table 1. Descriptive characteristics of pollutant variables in each air pollution station of the participating unit area.

Air pollution station	Pollutant		
	NO_2 (μg/m³) Median [IQR]	O_3 (μg/m³) Median [IQR]	PM10(μg/m³) Median [IQR]
Attica			
Agia Paraskevi	10.25 [7.08, 14.50]	81.54 [63.54, 100.98]	19.00 [14.17, 25.72]
Aristotelous	46.88 [37.50, 57.33]		33.00 [26.00, 43.29]
Thrakomakedones	6.17 [3.46, 10.50]	89.58 [71.81, 108.85]	20.00 [14.46, 29.00]
Lykovrysi	19.17 [11.36, 29.55]	62.12 [43.33, 83.25]	28.00 [21.00, 38.00]
Marousi	24.23 [13.95, 35.12]		
Nea Smyrni	27.58 [17.73, 39.92]	68.75 [47.67, 88.00]	27.29 [20.71, 34.96]
Patision	66.17 [51.33, 84.50]	16.79 [8.33, 30.81]	
Magnesia			
Volos			28.00 [21.00, 37.96]
Thessaloniki			
Agia Sofias	23.21 [17.41, 29.88]	44.19 [23.53, 64.58]	32.04 [21.00, 45.00]
Panorama	5.71 [2.92, 9.92]	83.25 [60.46, 106.50]	23.00 [16.00, 32.00]

Table 2. Percentage increase (95% CI) in the daily number of deaths related to cardiovascular and respiratory diseases per degree Celsius increase in apparent in 10 areas during warm periods.

Air pollution station	Unit area	NO_2	O_3	PM10
Agia Paraskevi	Attica	0.99 (0.92-1.06)	**1.02 (1.01-1.04)**	1.02 (0.99-1.05)
Aristotelous	Attica	1.00 (0.99-1.02)	-	1.01 (1.00-1.02)
Thrakomakedones	Attica	0.97 (0.89-1.06)	1.02 (1.00-1.04)	1.02 (0.98-1.06)
Lykovrysi	Attica	1.01 (0.98-1.04)	1.01 (0.99-1.03)	**1.03 (1.01-1.05)**
Nea Smyrni	Attica	1.01 (0.99-1.04)	1.01 (1.00-1.02)	**1.06 (1.03-1.09)**
Patision	Attica	1.01 (1.00-1.02)	1.00 (0.99-1.01)	-
Marousi	Attica	1.02 (0.99-1.05)	0.99 (0.98-1.01)	**1.06 (1.02-1.09)**
Volos	Magnesia	-	-	0.99 (0.95-1.03)
Agia Sofias	Thessaloniki	1.01 (0.99-1.03)	1.00 (1.00-1.01)	**1.02 (1.01-1.03)**
Panorama	Thessaloniki	**1.14 (1.00-1.31)**	1.01 (0.99-1.03)	1.03 (0.98-1.08)

Table 3. Percentage increase (95% CI) in the daily number of deaths related to cardiovascular and respiratory diseases per degree Celsius increase in apparent in 10 areas during cord periods.

Air pollution station	Unit area	NO_2	O_3	PM10
Agia Paraskevi	Attica	**1.07 (1.01-1.15)**	1.00 (0.98-1.01)	1.00 (0.98-1.02)
Aristotelous	Attica	**1.05 (1.03-1.06)**	-	**1.02 (1.02-1.03)**
Thrakomakedones	Attica	1.09 (1.00-1.19)	1.01 (0.99-1.03)	1.01 (0.98-1.03)
Lykovrysi	Attica	**1.07 (1.04-1.09)**	0.98 (0.97-1.00)	**1.02 (1.01-1.03)**
Nea Smyrni	Attica	1.00 (0.97-1.02)	0.99 (0.98-1.00)	**1.05 (1.02-1.08)**
Patision	Attica	**1.03 (1.01-1.04)**	1.00 (0.98-1.02)	-
Marousi	Attica	1.00 (0.97-1.03)	1.01 (0.99-1.03)	0.99 (0.97-1.02)
Volos	Magnesia	-	-	1.02 (1.00-1.04)
Agia Sofias	Thessaloniki	**1.04 (1.02-1.06)**	1.00 (0.99-1.01)	1.00 (1.00-1.01)
Panorama	Thessaloniki	1.04 (1.00-1.08)	0.99 (0.97-1.01)	1.00 (0.97-1.02)

DISCUSSION

The results showed that during both and warm periods there was an increase in deaths from cardiovascular and respiratory diseases associated with interaction of PM10 levels and apparent temperature(AT). In cold period, we found significant interaction between AT and NO2 concentrations for their effects on the total daily number of deaths for all ages.

CONCLUSION

This thesis examined the synergistic effects between temperature and air pollution on mortality and it found some evidence of synergistic effects between temperature and the mortality levels. These results require replication and evaluation in further studies.

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