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Correspondence

Impact of social containment measures on cardiovascular admissions and sudden cardiac death rates during Coronavirus Disease (COVID-19) outbreak in Greece

To address the coronavirus disease (Covid-19) pandemic, strict social containment measures have been adopted worldwide, while significant changes in the pattern of hospital admissions have been noted.¹⁻³ Reports from various countries have revealed an up to 60–70% decrease of admissions for acute coronary syndromes (ACS) during the early days of the outbreak¹⁻³. This trend has been theoretically attributed to a wide spectrum of causes; however, worrisome anecdotal reports suggest an increase of pre-hospital-care deaths related to ACS, potentially leading to the observed admissions' reduction.^{1,2} The aim of this study was to investigate the impact of social containment measures on ACS admission and sudden cardiac death (SCD) rates in Greece during the Covid-19 outbreak era.

Data for this analysis were retrieved from the official records of University Forensic Departments of Athens and Thessaloniki and the Forensic Science Service of Thessaloniki, Greece. Representative ACS admission data were collected through the University Cardiol-

corresponding control period from a year earlier was chosen (from March 15th to April 14th, 2019). ACS definition and classification of causes of death were based on the last published guidelines.^{4,5} The primary outcome was the frequency of ACSs and acute coronary deaths (ACDs). We also calculated incidence rates (IRs) for the primary outcome, by dividing the number of ACSs or deaths by the number of days. Incidence-rate ratios (IRR) comparing the case period to the control one were calculated using Poisson regression to model the number of ACS admissions or deaths per day. Statistical analysis was performed using Medcalc software (v.13.3.0.0.0, Ostend, Belgium), with p values < 0.05 considered to be statistically significant.

Overall, there has been a relative 38.9% reduction in ACS admissions in 2020, while 171 cases in 2020 vs 208 in 2019 were referred for autopsy in the enrolled forensic departments (Table 1). Gender and age distribution were not significantly different between the case and control periods. There were no statistically significant dif-

Table 1

Comparison of admission and sudden cardiac death rates in representative metropolitan areas of Greece between Covid-19 self-containment period in 2020 and control period in 2019

	2020 N (%)	2019 N (%)	IR 2020 (95% CI)	IR 2019 (95%CI)	IRR (95% CI)	p value
Total Admissions	182 (100%)	532 (100%)	6.07 (5.21–7.01)	17.73 (16.26–19.31)	0.34 (0.29–0.41)	<0.0005
ACS Admissions	33 (18.1%)	54 (10.2%)	1.1 (0.76–1.54)	1.8 (1.35–2.34)	0.61 (0.38–0.96)	0.02
Total Deaths	171 (100%)	208 (100%)	5.7 (4.88–6.62)	6.9 (6.02–7.94)	0.82 (0.67–1.01)	0.06
ACDs	81 (47.4%)	83 (39.9%)	2.7 (2.14–3.36)	2.8 (2.20–3.43)	0.98 (0.71–1.34)	0.88
VDs	33 (19.3%)	50 (23.9%)	1.1 (0.76–1.54)	1.67 (1.24–2.20)	0.66 (0.41–1.04)	0.06
Traffic Acc. Deaths	4 (2.3%)	20 (9.6%)	0.13 (0.04–0.34)	0.67 (0.41–1.03)	0.2 (0.05–0.60)	0.001
CVDs	13 (7.6%)	31 (14.9%)	0.43 (0.23–0.74)	1.03 (0.70–1.47)	0.42 (0.20–0.82)	0.007

The study period was defined as the time between the initiation of strict self-containment measures in Greece (March 15th 2020) and for one month (till April 14th 2020). The control period was a corresponding period from March 15th to April 14th, 2019—a year earlier. CI denotes confidence interval, IR: Incidence Rate, IRR: Incidence Rate Ratio, ACS: Acute Coronary Syndrome, ACDs: Acute Coronary Deaths, VDs: Violent Deaths, Traffic Acc. Deaths: Traffic Accident Deaths, CVDs: Cardiovascular Deaths other than ACDs (aortic aneurysm dissection/rupture, massive pulmonary embolism, intracerebral hemorrhage, and sudden cardiac death secondary to underlying cardiomyopathy). Data for this analysis were retrieved from the official records of University Forensic Departments of Athens and Thessaloniki and the Forensic Science Service of Thessaloniki, Greece, covering ~2.5 million people. Representative ACS admission data were collected through the University Cardiology Departments of Thessaloniki, Greece (corresponding to 1.5 million people). p values in bold are meant for statistical significance, while IRR values < 1 indicate a reduction of incidents in Covid-19 era.

ogy Departments of Thessaloniki, Greece (corresponding to a target population of 1.5 million people). The study period was defined as the time between March 15th 2020, when strict lock-down measures to contain the Covid-19 pandemic were implemented, till April 14th 2020. To compare admission and SCD rates, a

ferences in the frequency of deaths between the two periods examined, with the exception of deaths secondary to road traffic accidents [4(2.3%) in 2020 vs 20(9.6%) in 2019, p = 0.001] and non-ischemic cardiovascular deaths (p = 0.007) which significantly decreased during Covid-19 era.

In accordance with previous studies, we have shown a significant decrease in ACS-related hospitalization rates during the early

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days of the Covid-19 outbreak^{1,2} without a significant increase in autopsy-defined ACDs or cardiovascular-related mortality. Based on these data, our study provides, for the first-time, evidence that the observed decline in admissions' rate due to coronary syndromes could not be attributed to an increase in out-of-hospital ACDs. This tendency could be attributed either to the reluctance of patients experiencing ACS to visit emergency departments due to fear of contracting Covid-19 or alternatively to a change in lifestyle or everyday activities which may interfere with ACS presentation.

Our results should be seen in the light of some limitations. Firstly, it is a common practice in Greece for some death certificates to be issued even by general practitioners or family doctors without referral for autopsy. Even though this condition may have led to discounting some SCDs in the community, we feel that this number does not essentially affect the differences and frequencies reported, as this bias may exist during, pre-, and post-Covid-19 era. Another limitation is the lack of data from Covid-19 patients' autopsies (legally prohibited in our country) which could better classify death causes.

Our analysis offers evidence of a significant decrease in ACS-related hospitalization rates during Covid-19 outbreak. This decrease is not linked to an increase in pre-hospital, autopsy-defined ACDs, implying that many ACS patients may not ask for help on time due to fear of infection, though this makes them prone to late-onset complications. These clues may be used to appropriately form policies, such as ACS informative media campaigns or re-organization and expansion of pre-hospital triage and care services, which will facilitate and accelerate access of cardiovascular patients to health care systems during new pandemics' waves.

References

1. Tam CCF, Cheung KS, Lam S, et al. Impact of Coronavirus Disease 2019 (COVID-19) Outbreak on ST-Segment–Elevation Myocardial Infarction Care in Hong Kong, China. *Circ Cardiovasc Qual Outcomes*. 2020;13, e006631. <https://doi.org/10.1161/CIRCOUTCOMES.120.006631>.
2. Metzler B, Siostrzonek P, Binder RK, Bauer A, Reinstadler SJ. Decline of Acute Coronary Syndrome Admissions in Austria Since the Outbreak of COVID-19: The Pandemic Response Causes Cardiac Collateral Damage. *Eur Heart J*. 2020;41(19):1852–1853.
3. Lazaridis C, Vlachogiannis NI, Bakogiannis C, et al. Involvement of Cardiovascular System As The Critical Point in Coronavirus Disease 2019 (COVID-19) Prognosis and Recovery. *Hellenic J Cardiol*. 2020;S1109–9666(20):30093–30102. <https://doi.org/10.1016/j.hjc.2020.05.004>.
4. Thygesen K, Alpert JS, Jaffe AS, et al. Executive Group on behalf of the Joint European Society of Cardiology (ESC)/American College of Cardiology (ACC)/American Heart Association (AHA)/World Heart Federation (WHF) Task Force for the Universal Definition of Myocardial Infarction. Fourth Universal Definition of Myocardial Infarction (2018). *Circulation*. 2018;138(20):e618–e651.
5. International Classification of Diseases 10th Revision. Assessed through <https://who.int/classifications/icd/icdonlineversions/en/>.

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