Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Impact of Covid-19 lockdown on characteristics of autopsy cases in Greece. Comparison between 2019 and 2020

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ABSTRACT

In order to reduce transmission of COVID-19, social distancing measures were proposed, including spatial distancing (2 m distance), or even generalized lockdown. Main concern was to prevent overwhelming of the healthcare systems, mainly of the intensive care units (ICUs) by decreasing the spreading of the disease. In Greece, the Government, after consulting with experts in the fields of infectious disease and epidemiology, implemented a rather aggressive stance with an early lockdown.

Aim of our study, is to identify and compare the characteristics of cases referred for autopsy during the first month of the lockdown period for the COVID-19 outbreak, versus the cases referred during the same period in 2019.

231 autopsy cases were included in our study, 125 in 2019 and 106 in 2020. Regarding gender, age and nationality, no significant differences were detected between the two time periods. Age subgroup analysis demonstrated increased number of cases within the age group 70–79 years, in 2020.

As to the place of death, the increase in the percentage of out-of-hospital deaths was not confirmed as statistically significant. Regarding type of death (violent, sudden/unexpected), the drop of violent deaths in the 2020 examined period, was not confirmed as statistically significant; however, further subgroup analysis showed a significant drop of fatal injuries resulting from road traffic accidents in the 2020 period. The slight increase of sudden/unexpected deaths, especially myocardial infarction cases, did not reach statistical significance.

One month after lockdown, we cannot detect significant differences in the two time periods examined. Further study should be conducted soon when more data will become available. Frequency of fatal myocardial infarction seems to remain unaffected by the COVID-19 pandemic while deaths resulting from road traffic accidents exhibit a significant decrease. Homicides and suicides remain at low levels, in our jurisdiction area, seemingly unaffected by the COVID-19 outbreak and the subsequent lockdown.

It appears that since sudden/unexpected deaths, statistically remain unaffected, the preventive measures taken by the Greek authorities prevented overwhelming of the healthcare system, which could function properly.

1. Introduction

Around December 2019, Chinese authorities reported cases of acute respiratory syndrome in Wuhan City, Hubei province, China [1]. This disease was called coronavirus disease 2019 (COVID-19) and was identified to be caused by SARS-CoV-2 [2].

According to the European Centre for Disease Prevention and Control (ECDC), from 31st December 2019 to 21st April 2020, 2,431,890 cases of COVID-19 have been reported, of which 169,859 resulted in death [3].

The novel disease was characterized by asymptomatic transmission, sometimes intense severity and even risk of death (especially in case co-morbidities exist), lack of control options (no vaccine or effective antiviral therapy was available) and finally lack of widespread diagnostic testing [4].

In order to reduce transmission of COVID-19, social distancing measures were proposed, including spatial distancing (2 m distance) [5–8], or even generalized lockdown (e.g. nationwide closing of businesses, travel restrictions, controlled movement of individuals) [7,9]. Main concern was to prevent overwhelming of

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the healthcare systems, mainly of the intensive care units (ICUs) by decreasing the spreading of the disease [8,10].

In Greece, the Government, after consulting with experts in the fields of infectiology and epidemiology, implemented a rather aggressive stance that called for temporarily closing of theaters, cinemas, sports arenas, archaeological sites, congress venues already since early March, the closing of all schools, universities [11], churches and some retails businesses [12] since mid-March and finally the restrictions imposed on the free circulation of individuals [13].

Overall mortality in affected European countries, as demonstrated by relevant z-scores, presented a significant increase up to week-16 of 2020 [14,15]. In Greece during the same time period no such increase was noted (z-score<2) [15]. The standard score (z-score) is the number of standard deviations by which the value of a raw score is above or below the mean value of what is being observed.

Aim of our study, is to identify and compare the characteristics of cases referred for autopsy during the first month of the lockdown period for the COVID-19 outbreak, versus the cases referred during the same period in 2019.

2. Materials and methods

Our study sample comprises all forensic autopsy cases examined from March 17th till April 15th, 2019 (125 cases) and from March 17th till April 15th, 2020 (106 cases), in the Department of Forensic Medicine and Toxicology of the National and Kapodistrian University of Athens, in total 231 cases. All cases of our Department are referred by the Prosecutor, as they involve sudden/unexpected or violent deaths.

Medical history was obtained through hospital records and police information that accompanied the corpse, as well as through brief interviews with the relatives of the deceased.

Statistical analysis was performed using IBM SPSS Statistics Version 25 (IBM). Statistical significance was defined as a 2-sided P value of <0.05.

Descriptive results, such as frequency and percentage, were reported for all variables. Continuous Gaussian variables were reported as means with standard deviation (SD). Categorical variables were reported as numbers and percentages. *t*-Test and Pearson chi-square test (for continuous and categorical variables respectively) were appropriately used when comparison among variables was performed. Due to the relatively small size of our sample whenever Pearson Chi-Square Test was not applicable Fischer's exact test was used.

The jurisdiction area of our Department includes more than one third of the population of Attica (Athens metropolitan area). Our study sample includes only cases which were referred for autopsy, that obviously account only for a small fraction of the total number of deaths in our area of jurisdiction during the previously specified time frame.

Per directions of the National Organization for Public Health, suspected and confirmed cases of SARS-CoV-2 infection were not submitted to medicolegal investigation, as all morgues in Greece are not suitably equipped to perform autopsies of highly contagious cases [16].

3. Results

In total, 231 cases were included in our study, 125 in 2019 and 106 in 2020. In 2019, most cases were male (64.8%) of Greek origin (96.8%) and the mean age was 64.76 ± 20.03 years. In 2020, most of cases were male (55.7%) of Greek origin (94.3%). The mean age, during this period, was 67.4 ± 17.18 years.

Regarding gender, age and nationality, no significant differences were detected between the two time periods ($p = 0.157$, $p = 0.289$ and $p = 0.519$ respectively). Age subgroup analysis demonstrated

Table 1
Characteristics of cases.

Characteristics of Cases				
		2019	2020	p-value
Autopsies performed (N)		125	106	
Age (mean/median) ± SD years		(64.76/64) ± 20.034	(67.4/70.5) ± 17.175	0.289
Range (min/max)		95 (1/96)	96 (1/97)	
Gender N (%)	Male	81 (64.8%)	59 (55.7%)	0.157
	Female	44 (35.2%)	47 (44.3%)	
Nationality N (%)	Greek	121 (96.8%)	100 (94.3%)	Fisher's 0.519
	Other	4 (3.2%)	6 (5.7%)	
Age Groups N (%)	0–9 years	2 (1.6%)	1 (0.9%)	0.266
	10–19 years	1 (0.8%)	0 (0.0%)	
	20–29 years	4 (3.2%)	3 (2.8%)	
	30–39 years	5 (4.0%)	2 (1.9%)	
	40–49 years	13 (10.4%)	9 (8.5%)	0.622
	50–59 years	27 (21.6%)	15 (14.2%)	0.144
	60–69 years	17 (13.6%)	19 (17.9%)	0.367
	70–79 years	20 (16%)	31 (29.2%)	0.016
	80–89 years	22 (17.6%)	20 (18.9%)	0.803
	90–99 years	14 (11.2%)	6 (5.7%)	0.136
Place of Death N (%)	Hospital	99 (79.2%)	73 (68.9%)	0.073
	Out-of-Hospital	26 (20.8%)	33 (31.1%)	
Death Type N (%)	Undetermined	3 (2.4%)	1 (0.9%)	Not performed due to sample size
	Violent	32 (25.6%)	18 (17%)	0.113
	Sudden/Unexpected	89 (71.2%)	87 (82.1%)	0.053
Manner of Death in Violent Deaths N (%)	Homicide	3 (2.4%)	2 (1.9%)	Not performed due to sample size
	Suicide	6 (4.8%)	4 (3.8%)	
	Accident	19 (15.2%)	7 (6.6%)	
	Undetermined	4 (3.2%)	5 (4.7%)	
Specific Cause of death N (%)	MI	56 (44.8%)	53 (50%)	0.430
	RTA	14 (11.2%)	3 (2.8%)	0.015

increased number of cases within the age group 70–79 years, in 2020 ($p = 0.016$).

As to the place of death, the increase in the percentage of out-of-hospital deaths was not confirmed as statistically significant ($p = 0.073$).

Regarding type of death (violent, sudden/unexpected), the drop of violent deaths in 2020 examined period, was not confirmed as statistically significant ($p = 0.113$); however, further subgroup analysis showed a significant drop of fatal injuries resulting from road traffic accidents in the 2020 period ($p = 0.015$).

Sudden/unexpected deaths did not exhibit any significant variation ($p = 0.053$). Detailed results are presented in Table 1.

4. Discussion

Spread of COVID-19 in Europe and worldwide evolved quite rapidly, involving many European countries, such as Italy [17], Spain [18] and France [19]. Many countries, such as the United Kingdom, initially adopted a quite different strategy to counter COVID-19 spreading, but rather soon after they also enacted social distancing policies [8]. On the other hand, Greece adopted a rather aggressive stance by timely closure of educational institutions, recreational facilities, and finally business, to minimize the spread of the virus and to ease the burden imposed on its healthcare system. Timing of emergency measures seems to be critical, as besides Greece, this was proven also in Germany [20].

The rapid adoption of emergency measures in Greece, in all relevant sectors of life (health system, education, public safety, economy), prevented hospitals from being overwhelmed and allowed prompt and correct medical care of cases, not limited only to the COVID-19 outbreak. The later was duly noted in European press, as Greece was exiting a ten-year economic crisis and such good results came as a surprise [21,22]. Furthermore the public widely accepted the enacted emergency measures, as demonstrated by opinion polls [23].

Nevertheless, people may die of various causes that do not cease to exist even during lockdown periods.

Medicolegal investigation of confirmed COVID-19 cases usually falls out of the scope of forensic work, as the cause of death is already known. On the other hand, any case of sudden death handled in the mortuary, may be potentially infectious, even with SARS-CoV-2. The National Organization for Public Health issued a guideline, in which it is clearly stated that post-mortem examination (PME) of confirmed or suspected COVID-19 cases should be avoided whenever possible [16]. Autopsies on known or suspected COVID-19 cases should be conducted in Airborne Infection Isolation Rooms [24,25]. Unfortunately, mortuaries in Greece are not adequately equipped to handle such cases.

Thus, all cases, were submitted to meticulous history taking before the PME onset, to identify COVID-19 suspicious cases. No confirmed COVID-19 case was referred to our Department. Some cases had already been submitted to in vivo testing for SARS-CoV-2, and their results accompanied the corpse. All cases of sudden/unexpected death were handled as potentially contagious and were handled with extreme caution, in accordance with the general principles for the protection of personnel [16,24]. Keeping in mind that the time of realization of our study involved the early stages of the spread of the virus in Greece, as SARS-CoV-2 is highly contagious, we followed meticulously the instructions given by the Authorities. Fortunately, more recently, SARS-CoV-2 testing became available for every suspicious autopsy case.

After approximately one month, we decided to study the impact of the lockdown on the characteristics of cases referred to our Department for PME.

Concerning age, nationality and gender, our analysis did not reveal any statistically significant differences, except for age group 70–79 years that presented an increase in 2020. This finding deserves further study soon when more data will become available.

We hypothesized that COVID-19 outbreak would have an impact on patient with other morbidities such as cardiovascular diseases. Receiving feedback by colleagues practicing various clinical specialties, we were informed of a drop in admitted cases for reason other than COVID-19 (including cardiovascular incidents). This impression is also based on available literature, where a significant drop either in ST elevation MI cases or in primary percutaneous interventions are noted [26,27]. On the other hand literature suggests delays in the treatment of patients presenting with myocardial infarction (MI), that could lead to increased mortality [28]. Our analysis did not indicate any statistically significant difference in fatal MI cases within the time periods examined. This is probably explained by the fact that severe and extended MIs continue to be fatal, while other, in less severe cases, patients probably hesitate to visit a hospital. According to the feedback received by many clinical cardiologists, an increase in new heart failure cases due to non-fatal MIs that were not treated in hospitals, is to be expected soon.

As to the place of death we hypothesized that many patients would be reluctant to visit a hospital during the outbreak, thus leading to an increase of out-of-hospital deaths [28]. Our analysis did not confirm statistical significance of noted differences.

Regarding violent deaths, the noted decrease did not reach statistical significance, except for deaths resulting from injuries sustained by traffic accidents, which can be explained by the reduced number of vehicles in circulation during the lockdown.

5. Conclusion

We conclude that one month after lockdown, we cannot detect significant differences in the two time periods examined. Further study should be conducted in the near future, when more data will become available. Further research concerning death certificates for the specific time in question, might help answer whether the pandemic caused any changes in mortality patterns overall.

Frequency of fatal MI seems to remain unaffected by the COVID-19 pandemic while deaths resulting from road traffic accidents exhibit a significant decrease. Homicides and suicides remain at low levels, in our jurisdiction area, seemingly unaffected by the COVID-19 outbreak and the subsequent lockdown.

It appears that since sudden/unexpected deaths, statistically remain unaffected, the preventive measures taken by the Greek authorities prevented overwhelming of the healthcare system. Should any overwhelming of the health services had occurred, we would have expected more out-of-hospital deaths, referred by the Prosecutor. Fortunately, the latter did not occur.

Finally, as demonstrated by our results, information derived from forensic autopsies, by providing early warning in patterns of mortality within the community, yet another time, prove to be an invaluable public health asset.

CRediT authorship contribution statement

Emmanouil I. Sakelliadis: Conceptualization, Writing - original draft, Writing - review & editing. **Konstantinos D. Katsos:** Resources, Data curation, Writing - review & editing. **Evmorfili I. Zouzia:** Formal analysis. **Chara A. Spiliopoulou:** Conceptualization, Writing - review & editing, Supervision. **Sotirios Tsiodras:** Writing - review & editing, Supervision.

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