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## The burden of the pandemic on the non-SARS-CoV-2 emergencies: A multicenter study



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### ABSTRACT

**Background:** Governments have implemented social distancing interventions to curb the speed of SARS-CoV-2 spread and avoid hospital overload. SARS-CoV-2 social distancing interventions have modified several aspects of society, leading to a change in the emergency medical visit profile.

**Objective:** To analyze the impact of COVID-19 and the resulting changes on the non-SARS-CoV-2 emergency medical care system profile.

**Methods:** This is a retrospective multicenter cross-sectional study evaluating medical consultations, urgent hospitalizations, and deaths in São Paulo, the largest city of the Americas. Changes in the medical visit profile according to demographic data and diagnoses were assessed. The change in mortality was also assessed.

**Results:** A total of 462,412 emergency medical visits were registered from January 2019 to July 2020. Of these emergency medical visits, only 4.7% (21,653) required hospitalization. Of all visits, 592 resulted in deaths, equivalent to 0.1% of the sample. There was a clear decreasing trend in the number of weekly emergency medical visits as social distancing was mandated by decree (Coef. -3733.13; 95% CI -4579.85 to -2886.42;  $p < 0.001$ ). The number of medical visits for conditions such as trauma, abdominal pain, chest pain, and the common cold decreased ( $p < 0.05$ ). However, the number of medical visits for the following conditions did not change after the onset of the pandemic ( $p \geq 0.05$ ): ureterolithiasis, acute appendicitis, acute cholecystitis, acute myocardial infarction, and stroke.

**Conclusion:** The COVID-19 pandemic has changed the non-SARS-CoV-2 emergency profile. The overall number of emergency medical visits has reduced. The mortality of non-SARS-CoV-2 emergencies has not increased in São Paulo.

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### 1. Introduction

The WHO first reported coronavirus disease 2019 (COVID-19), the disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, on December 31, 2019, after Chinese authorities reported a series of mysterious pneumonia cases in Wuhan [1]. Since then, over 66 millions of new cases have been reported, with over 1.5 million deaths [2]. The current generation of health-care professionals has never seen such a devastating spread of an infectious disease as it has with COVID-19.

Governments have implemented social distancing interventions to reduce the speed of SARS-CoV-2 spread and avoid hospital overload, and home confinement measures have been ordered in most countries [3,4]. Patients were advised by the authorities to stay home unless they had a severe condition.

Consequently, SARS-CoV-2 social distancing interventions have changed several aspects of society, including social and entertainment activities, traffic, and job routines, and even psychosocial patterns, which may have changed the demand profiles for all medical emergencies [5–7]. While previous studies dealt with specific disease or condition during a pandemic period, literature lacks of an overview of all medical conditions burden on the emergency department. Several diseases that were highly incident before the pandemic are still common, and currently, the whole emergency care system must shoulder both SARS-CoV-2 and non-SARS-CoV-2 emergencies.

Social distancing measures were enacted on March 22, 2020, in the state of São Paulo, Brazil. From this moment on, face-to-face services in commercial establishments, nightclubs, shopping centers, schools, and gyms were no longer allowed. Only essential services, such as health, food, drug, security, and supply services, were permitted (Decree N° 64.881; State of São Paulo, March 22, 2020).

Knowing the changes in emergency health-care system patterns allows authorities to direct health-resource allocation. This study aims to

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analyze the impact of the COVID-19 and the resulting changes on the non-SARS-CoV-2 emergency profile.

## 2. Methods

This is a retrospective multicenter cross-sectional study evaluating medical consultations, urgent hospitalizations, and deaths in São Paulo, of all non-SARS-CoV-2 emergencies (all COVID-19-related conditions were excluded). Data were extracted from the records of all emergency hospitalizations and deaths at emergency care hospitals of the Albert Einstein System, all of them located in São Paulo. São Paulo is the largest city of the Americas, comprising more than 21 million inhabitants and was where the first COVID-19 case was diagnosed in South America. It is the leading city in Brazil in number of COVID-19 cases, with almost 0.5 million cases [8].

The Albert Einstein System is a non-profit health society that has established several partnerships with the São Paulo Health Department, implementing healthcare services. The present study included nine emergency care units (*Unidade de Pronto Atendimento*) managed by the Albert Einstein System in São Paulo.

All patients of the emergency care units were included. All patients were evaluated by physicians. In this observational study, the exposition was the social distancing period, and the outcome variable was the number of medical visits. Thus, the change in the number and profile of emergency visits across months in the 2019–2020 period according to sex, age, specialty, and diagnosis were assessed, and a comparison was made before and after the social distancing decree (March 22, 2020). The Albert Einstein Ethics Committee approved this study (CAAE: 32353120.2.0000.0071). STROBE statement was followed for reporting [9].

### 2.1. Statistical analysis

Continuous variables were described by means and standard deviations or medians and interquartile ranges. Categorical variables were shown as relative and absolute frequencies. Comparisons between continuous variables were performed using the Mann-Whitney test.

All hospitals included in this study use a common medical chart system in which all clinical data are prospectively inserted. An epidemiologist abstracted the variables of interest. The data were transferred to a computed database for subsequent statistical analysis. The epidemiologist was blinded to the study hypothesis. All medical visits of the emergency care units with non-SARS-CoV-2 related conditions were included.

The number of emergency care visits over time and its relationship with the onset of social distancing in the state of São Paulo were assessed by time series regression models, with autoregressive integrated moving average. The number of visits in the period was the response variable and the beginning of the pandemic was the explanatory variable. The R (R Core Team, 2015) and forecast (Hyndman et al., 2008) packages and the statistical software Statistical Package for the Social Sciences - SPSS, v26.0, (IBM Corp, 2019) were used. The level of significance adopted was 0.05.

## 3. Results

A total of 462,412 emergency medical visits were registered from January 2019 to July 2020. All medical visits of the emergency care units with non-SARS-CoV-2 related conditions were included, and charts for 4248 (<1%) visits were missing information concerning the outcome “death or discharge”. These were excluded only from analysis of this outcome. No other exclusion criteria were adopted. No other exclusion criteria were adopted. 4.7% (21,653) of patients were hospitalized. Of all visits, 592 resulted in deaths, equivalent to 0.1% of the sample (see Fig. 1). In the casuistry, there was a slight female predominance (58%). The majority of the patients were children and adolescents (<16 years-old), or adults (<45 years-old). The main emergency department consultations were directed to general practitioners (52%); pediatrics (27%); and surgeons (25%). The baseline characteristics of the patients are shown in Table 1. (See Table 2.)

A clearly decreasing trend was observed in the number of weekly emergency medical visits as social distancing was mandated by decree (Coef. -3733.13; 95% CI -4579.85 to -2886.42;  $p < 0.001$ ). The number of medical visits decreased for all age groups, sexes, and specialties. The number of medical visits for several conditions have dropped, such as traumatic brain injury (Coef. -16.21; 95% CI -22.82 to -9.61;  $p < 0.001$ ); polytrauma (Coef. -0.88; 95% CI -1.71 to -0.05;  $p = 0.039$ ); scalp and facial injury (Coef. -22.54; 95% CI -28.75 to -16.33;  $p < 0.001$ ); abdominal pain (Coef. -93.05; 95% CI -115.29 to -70.81;  $p < 0.001$ ); acute diverticulitis (Coef. -6.55; 95% CI -9.08 to -4.02;  $p < 0.001$ ); chest pain (Coef. -43.23; 95% CI -59.01 to -27.45;  $p < 0.001$ ). An intense reduction in the common cold visits, non-related to SARS-CoV-2 infection, was also observed (Coef. -121.87; 95% CI -170.99 to -72.75;  $p < 0.001$ ). However, the number of visits for the following conditions did not change after pandemic onset: ureterolithiasis (Coef. -12.91; 95% CI -27.75 to 1.93;  $p = 0.088$ ); acute appendicitis (Coef. -1.57; 95% CI -3.39 to 0.26;  $p = 0.092$ ); acute cholecystitis (Coef. -1.32; 95% CI -2.74 to 0.10;  $p = 0.067$ ); acute myocardial infarction (Coef.

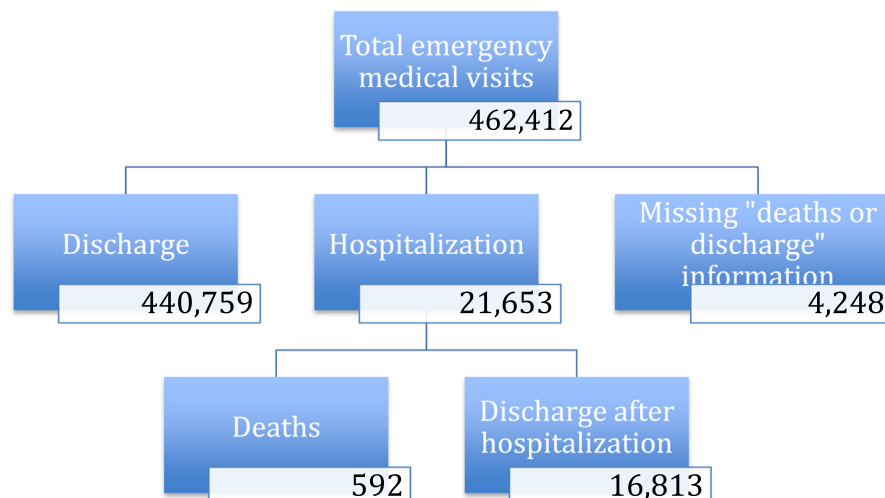


Fig. 1. Flow diagram of all the emergency medical visits registered from January 2019 to July 2020.

**Table 1**  
Baseline characteristics of the patients in the period from January 2019 to July 2020

Baseline characteristics	Before pandemic	%	Pandemic period	%
All	427,976	100	34,436	100
Sex				
Female	229,323	53.6	18,208	52.9
Male	198,629	46.4	16,223	47.1
Age				
< 16 years	138,819	32.4	4965	14.4
16 to 29 years	54,580	12.8	3978	11.6
30 to 44 years	124,647	29.1	12,500	36.3
45 to 59 years	66,213	15.5	7848	22.8
60 to 74 years	27,698	6.5	3179	9.2
>74 years	16,019	3.7	1966	5.7
Diagnosis				
Traumatic brain injury	2480	0.6	336	1
Polytrauma	111	<0.1	13	<0.1
Scalp and facial injury	3663	0.9	553	1.6
Abdominal pain	10,259	2.4	907	2.6
Ureterolithiasis	3230	0.8	691	2
Acute appendicitis	706	0.2	160	0.5
Acute diverticulitis	947	0.2	130	0.4
Acute cholelithiasis	287	0.1	54	0.2
Chest pain	6748	1.6	964	2.8
Acute myocardial infarction	189	<0.1	56	0.2
Stroke	135	<0.1	20	0.1
Common cold	11,802	2.8	521	1.5
Specialty				
General practitioner	203,561	47.6	20,410	59.3
Surgery	97,867	22.9	8922	25.9
Pediatrics	112,887	26.4	3430	10
Gynecology	9567	2.2	1295	3.8
Others	4094	1	379	1.1

-0.53; 95% CI -1.49 to 0.43;  $p=0.282$ ); and stroke (Coef. -0.65; 95% CI -1.41 to 0.12;  $p<0.001$ ). A significant reduction in hospital admissions was identified (Coef. -68.51; 95% CI -102.33 to -34.69;  $p<0.001$ ). No significant increase in the number of deaths associated with non-SARS-CoV-2 emergencies was observed after the pandemic onset and social distancing decree in São Paulo (Coef. 0.22; 95% CI -1.3 to -1.74;  $p=0.777$ ). The mean numbers of monthly emergency medical visits and deaths are illustrated in Figs. 2 and 3.

#### 4. Discussion

These multicenter study results show that the number of emergency visits for most non-SARS-CoV-2-related conditions was greatly reduced. However, this was not the case for some nontraumatic surgical emergencies and cardiovascular emergencies. Fortunately, the mortality of non-SARS-CoV-2 emergencies has not significantly increased after pandemic onset and the social distancing decree in São Paulo.

One of the biggest fears of the SARS-CoV-2 pandemic was that COVID-19 would rapidly increase mortality due to non-SARS-CoV-2 emergencies with the collapse of health services due to COVID-19 [10]. The dramatic change in the emergency medical visit profile probably helped in some way to avoid an expressive increase in the mortality of non-SARS-CoV-2 emergencies.

The intense reduction in traffic probably changed the trauma emergency service profile, explaining the large reduction in traumatic injuries. Land-based transport accidents are quite relevant in São Paulo due to heavy traffic and many motorcycles [11,12]. Many trauma-related injuries are caused by car crashes, motorbike accidents, accidents involving pedestrians, or bicycle accidents [12]. Consequently, the reduced traffic density may have affected the number of these accidents.

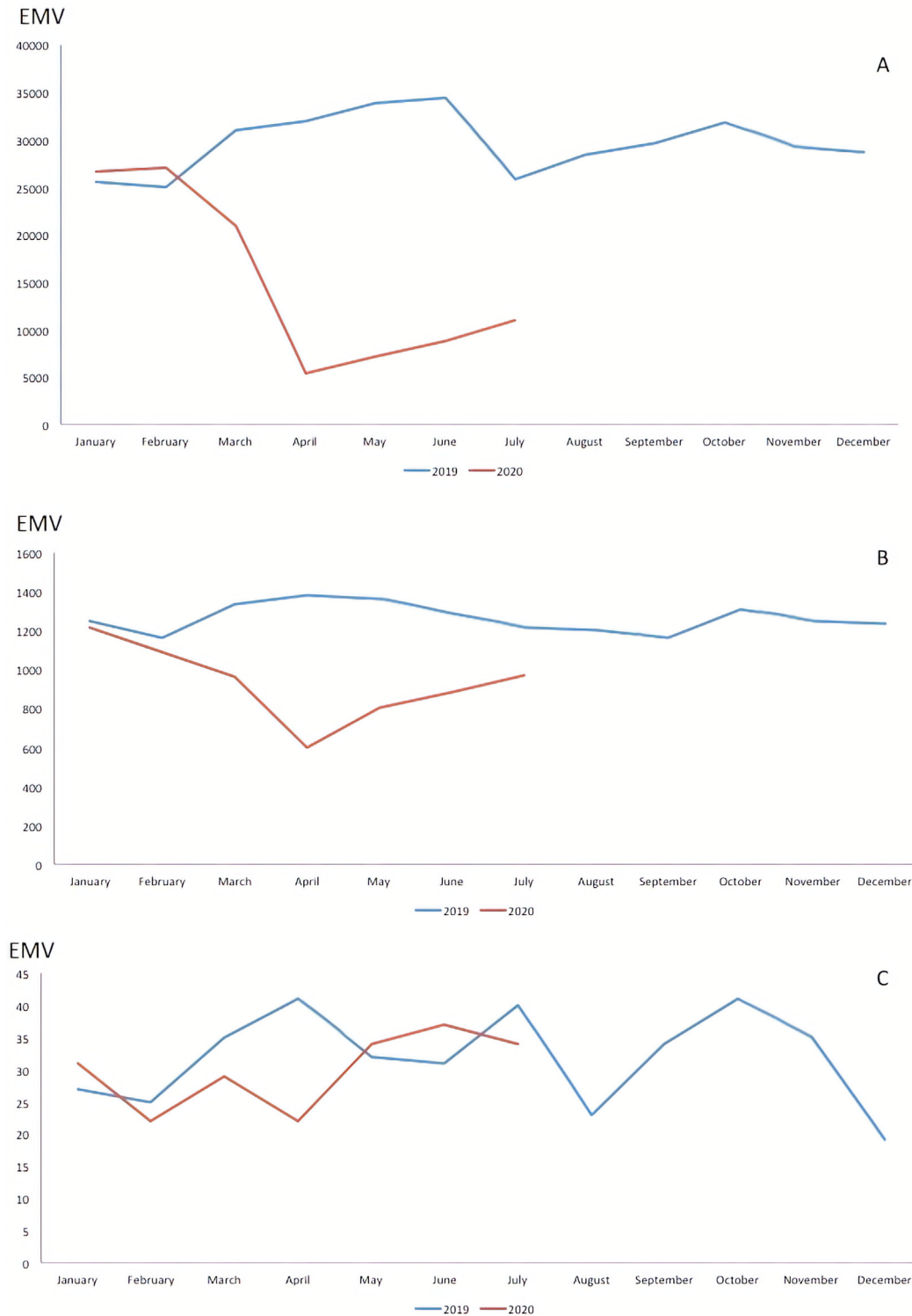
**Table 2**  
The change in the number of emergency medical visits after pandemic onset

	Coef.	95% CI		p-value
		Lower	Upper	
Overall number of emergency medical visits	-3733.13	-4579.85	-2886.42	<0.001
Sex				
Female	-2126.85	-2445.21	-1808.49	<0.001
Male	-1718.83	-2119.49	-1318.16	<0.001
Specialties				
General practitioner	-1696.73	-1951.95	-1441.52	<0.001
Surgery	-861.96	-1080.81	-643.11	<0.001
Pediatrics	-1260.55	-1564.85	-956.24	<0.001
Gynecology	-52.27	-79.68	-24.87	<0.001
Age				
< 16 years	-1521.84	-1890.09	-1153.60	<0.001
16 to 29 years	-525.68	-576.35	-475.01	<0.001
30 to 44 years	-1051.18	-1191.96	-910.40	<0.001
45 to 59 years	-494.80	-613.81	-375.80	<0.001
60 to 74 years	-198.93	-247.70	-150.17	<0.001
>75 years	-120.66	-148.04	-93.28	<0.001
Diagnostic				
Traumatic brain injury	-16.21	-22.82	-9.61	<0.001
Polytrauma	-0.88	-1.71	-0.05	0.039
Scalp and facial injury	-22.54	-28.75	-16.33	<0.001
Abdominal pain	-93.05	-115.29	-70.81	<0.001
Ureterolithiasis	-12.91	-27.75	1.93	0.088
Acute appendicitis	-1.57	-3.39	0.26	0.092
Acute diverticulitis	-6.55	-9.08	-4.02	<0.001
Acute cholelithiasis	-1.32	-2.74	0.10	0.067
Chest pain	-43.23	-59.01	-27.45	<0.001
Acute myocardial infarction	-0.53	-1.49	0.43	0.282
Stroke	-0.65	-1.41	0.12	0.098
Common cold	-121.87	-170.99	-72.75	<0.001
Outcome				
Discharge after initial evaluation	-3744.44	-4551.98	-2936.90	<0.001
Hospital admission after initial evaluation	-68.51	-102.33	-34.69	<0.001
Death or discharge				
Hospital discharge	-3787.86	-4614.01	-2961.71	<0.001
Death	0.22	-1.30	1.74	0.777

Additionally, it is well known that several types of interpersonal violence occur in streets. The end of parties, the closure of pubs and bars, and the comprehensive ban of large gatherings may have helped reduce these causes of trauma [13]. On the other hand, restrictive measures may have changed the victim profile. The home confinement orders left many victims trapped with their aggressors. Domestic violence increased during the pandemics [14]. Restrictive measures may also have adversely impacted mental health, which would favor interpersonal violence and self-harm behavior [15].

The number of emergency medical visits due to abdominal pain, chest pain, and the common cold has also meaningfully reduced after the onset of the pandemic. Patients with mild symptoms probably did not seek medical care, which would have happened before home confinement measures. On March 23rd, people were vaccinated against the most common influenza strains (subtype A/H1N1 and H3N2; and subtype B/Victoria) throughout São Paulo city [16]. Flu vaccination can affect the number of fever patients visiting the emergency room, and avoid overburdening health services [17]. Additionally, mask wearing, hand hygiene, and social distancing during the COVID-19 pandemic may have helped to reduce transmission of the common cold [18].

Some medical conditions did not change after home confinement orders. These conditions include non-SARS-CoV-2-related acute myocardial infarction and stroke. It is essential for health-care providers to

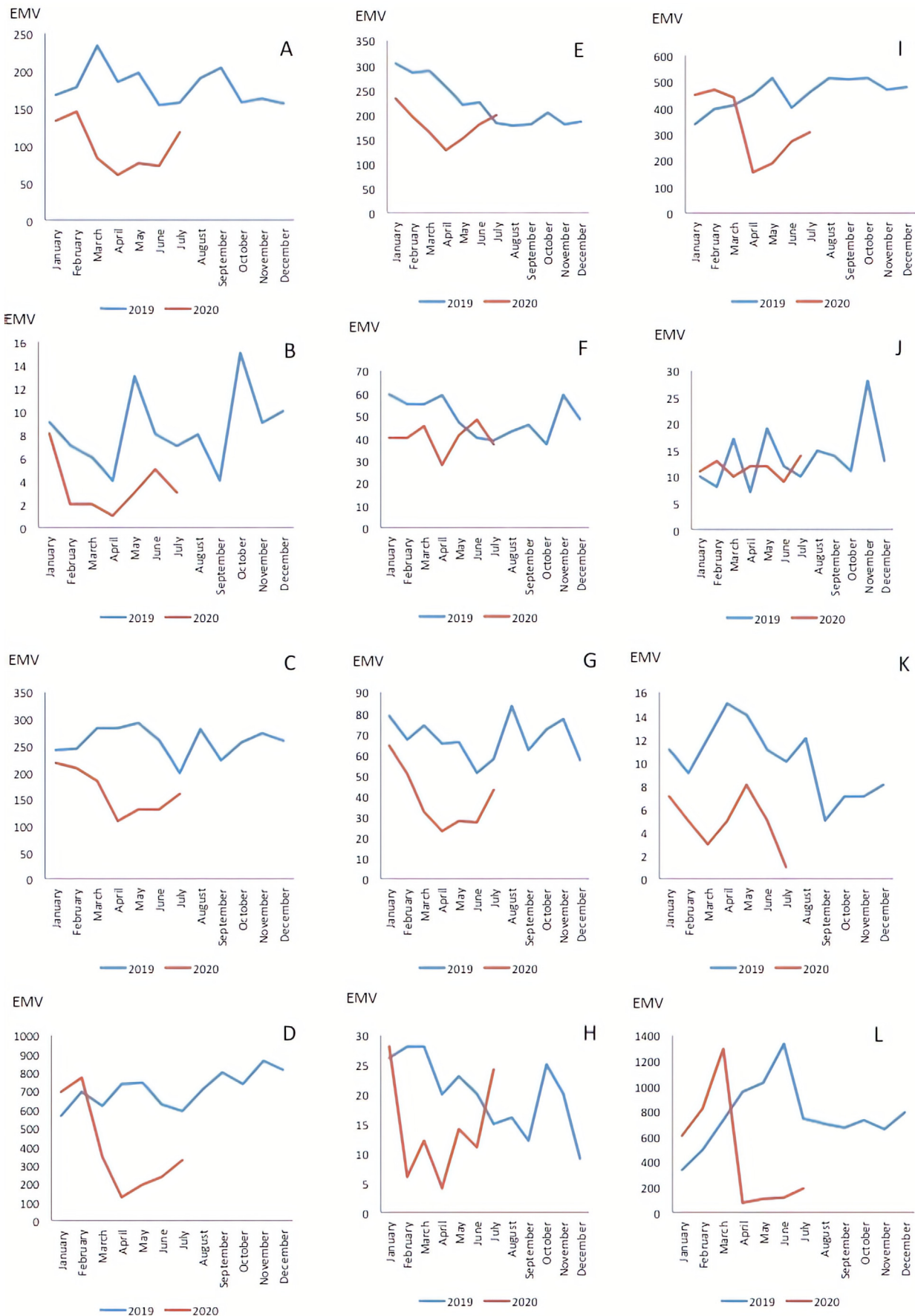


**Fig. 2.** The change in the mean number of emergency medical visits (EMV) in 2019 and 2020. A: The overall number of emergency medical visits; B: The number of hospital admissions; C: The number of deaths.

allocate resources for these conditions. Cardiovascular intensive care resources are already burdened by COVID-19-related cardiovascular complications [19]. Additionally, ureterolithiasis, acute cholelithiasis, and acute appendicitis are conditions that have not been reduced after pandemic onset. Several of these conditions demand surgical intervention,

and hospitals have to cope with and address emergency surgeries. Care should be taken to avoid transmission for patients and medical staff during these surgeries [20,21].

Giamello et al. [22], in an Italian two-center study that comprises over 45,000 emergency department examinations annually, showed a



**Fig. 3.** The change in the mean number of emergency medical visits (EMV) in 2019 and 2020 according to the diagnosis. A: Traumatic brain injury; B: Polytrauma; C: Scalp and facial injury; D: Abdominal pain; E: Ureterolithiasis; F: Acute appendicitis; G: Acute diverticulitis; H: Acute cholelithiasis; I: Chest pain; J: Acute myocardial infarction; K: Stroke; L: Common cold.

significant drop in the emergency visits for anxiety, back and joint pain, abdominal pain, general malaise, dizziness in 2020 compared to 2019. Unlike our findings, they observed a reduction in acute coronary syndrome cases. De Filippo et al. [23], in a study comprising 15 hospitals in Italy focused on coronary admissions, also showed a significant reduction on acute coronary syndrome on the pandemic period. However, as noted by Vecchio et al. [24], the number of intensive care admissions for non-primarily cardiac conditions has raised. Probably the reduction on non-SARS-CoV-2 coronary syndrome is due to the fact that several cases of acute myocardial infarction have been diagnosed as COVID-19 related complications [19]. Thus, policymakers should keep special attention on coronary syndrome in the pandemic period, both for SARS-CoV-2 and non-SARS-CoV-2 related conditions.

This study has some limitations. The retrospective nature and large sample size of this multicenter work resulted in high heterogeneity among patients, diseases, hospitals, and emergency management protocols. Although the external validity of the present findings is undeterminable, São Paulo showcases all the significant challenges inherent in several worldwide metropolises concerning society's complexity and density, health system network, traffic, and violence, among others. Future population-based studies will be necessary to determine the validity of the findings of the present study in other major metropolises with longer follow-up. Also, future studies also should focus on the specific mortality, according to each disease category.

## 5. Conclusion

The COVID-19 pandemic has changed the non-SARS-CoV-2 emergency profile. The overall number of emergency medical visits has reduced, and the mortality of non-SARS-CoV-2 emergencies has not increased.

The study was not funded.

## Author contributions

Wolosker was responsible for the study conception and design, manuscript preparation and critical revisions. Steinman was responsible for the acquisition of data, statistical analyses, data interpretation, and critical revisions. Tustumi was responsible for the data acquisition and interpretation, and statistical analyses. De Souza was responsible for the statistical analyses, data interpretation and critical revisions and was responsible for the study conception and design, and critical revisions. All of the authors approved the final version of the manuscript.

## Ethics

The local ethics committee approved the study.

## Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declaration of Competing Interest

The authors declare that they have no conflict of interest.

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