

openheart Global effect of COVID-19 pandemic on the rate of acute coronary syndrome admissions: a comprehensive review of published literature

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ABSTRACT

Background The COVID-19 pandemic has disrupted healthcare systems across the world. The rate of acute coronary syndrome (ACS) admissions during the pandemic has varied significantly.

Objectives The purpose of this study is to investigate the effect of the pandemic on ACS hospital admissions and to determine whether this is related to the number of COVID-19 cases in each country.

Method Search engines including PubMed, Embase, Ovid and Google Scholar were searched from December 2019 to the 15 September 2020 to identify studies reporting ACS admission data during COVID-19 pandemic months in 2020 compared with 2019 admissions.

Results A total of 40 studies were included in this multistudy analysis. They demonstrated a 28.1% reduction in the rate of admission with ACS during the COVID-19 pandemic period compared with the same period in 2019 (total of 28 613 patients in 2020 vs 39 225 in 2019). There was a significant correlation between the absolute risk reduction in the total number of ACS cases and the number of COVID-19 cases per 100 000 population (Pearson correlation=0.361 (p=0.028)). However, the correlation was not significant for each of the ACS subgroups: non-ST-elevation myocardial infarction (STEMI) (p=0.508), STEMI (p=0.883) and unstable angina (p=0.175).

Conclusion There was a significant reduction in the rate of ACS admission during the COVID-19 pandemic period compared with the same period in 2019 with a significant correlation with COVID-19 prevalence.

INTRODUCTION

The SARS-CoV2 viral pandemic has disrupted healthcare systems across the world, forcing them to efficiently adapt to the overwhelming increase in acutely and devastatingly ill patients diagnosed with COVID-19.^{1–3} During this period, acute coronary syndrome (ACS) admissions have been lower than the pre-pandemic admission rates.⁴ This phenomenon has been observed worldwide and has been attributed to the increased patient concern of presenting to the hospital, improved medication compliance and less

Key questions

What is already known about this subject?

- ▶ A COVID-19 pandemic has a huge impact on health-care systems across the world.

What does this study add?

- ▶ How did COVID-19 affect acute coronary syndrome (ACS) admissions rate globally.
- ▶ There is a correlation between the drop of ACS admission rate and the number of COVID-19 cases in each country.

How might this impact on clinical practice?

- ▶ It highlights the importance of increasing the public awareness about presenting with ACS during the pandemic if required.
- ▶ Healthcare systems need to be prepared to face the potential consequences of late and missed ACS presentations.

physical strain, and decreased levels of pollution and smoke exposure due to quarantine measures.⁵

The purpose of this multistudy analysis was to investigate the impact of COVID-19 pandemic on hospital admissions for ACS and study the relation to published numbers of COVID-19 infections per 100 000 of the population in each country.

METHODOLOGY

Preferred Reporting Items for Systemic Reviews and Meta-Analyses statement was followed for the conduct and reporting of this meta-analysis.⁶

Data source, search strategy and inclusion

To identify all the studies demonstrating the impact of the COVID-19 pandemic on the number of hospital admissions for patients with ACS, PubMed, Embase, Ovid and Google Scholar were carefully searched for any

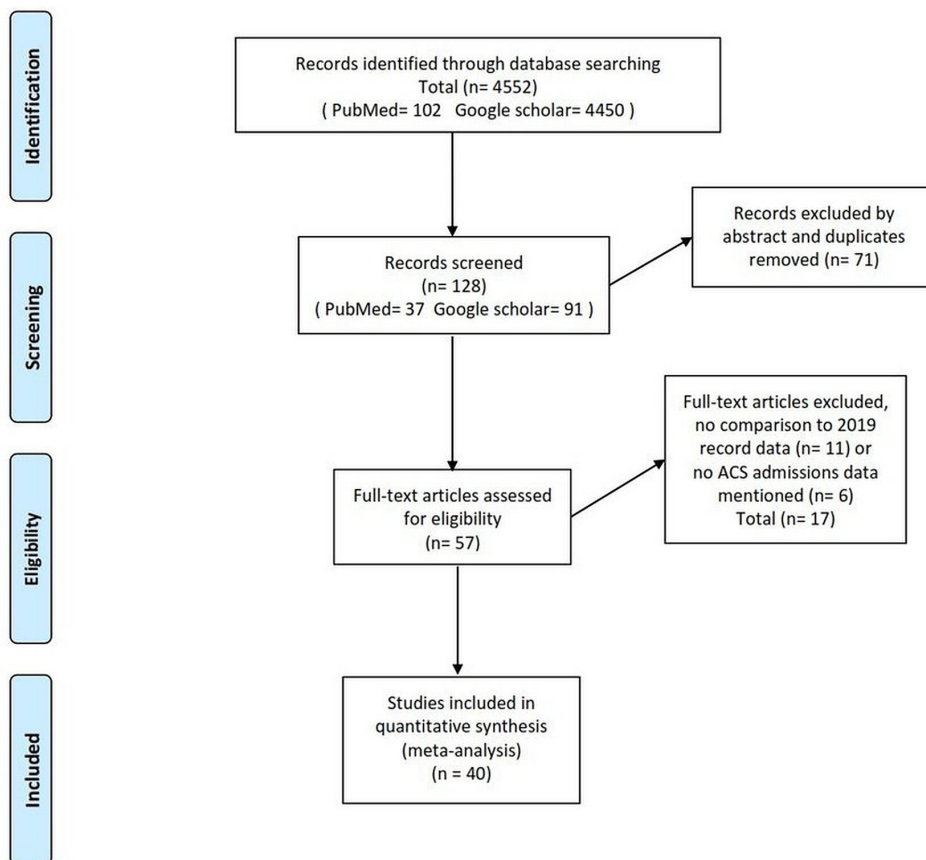


Figure 1 Meta-analysis screening system. ACS, acute coronary syndrome.

published data from December 2019 to the 15 September 2020.

The following search keywords were used alone or in combination: ‘novel coronavirus’, ‘SARS-CoV2’, ‘COVID-19’, ‘ACS’, ‘cardiovascular disease’, ‘cardiac injury’, ‘STEMI’, ‘non-STEMI’ and ‘unstable angina.

Inclusion criteria for this multistudy analysis were any comparative study published in English or has a published English translation reporting ACS admission data during COVID-19 pandemic months and comparing it to 2019 admission data. The pandemic month was identified by the detection of the first case of COVID-19 according to the study original country. Studies without adequate admission data or no comparison to 2019 were excluded. (figure 1)

Data extraction and study quality assessment

According to the study, any reported data for ACS, non-ST-elevation myocardial infarction (STEMI), STEMI or unstable angina (UA) admission numbers in 2019 and 2020 were extracted. In addition to the date of the first recognised case of COVID-19. The primary outcome measure was to compare the number of admissions in both years. Newcastle-Ottawa scale was used to assess the quality of the studies.

Data synthesis and statistical analysis

The data are described as mean \pm SD, median, range and IQR or frequencies (number of cases) and

percentages when appropriate. Absolute risk reduction (reduction in the number of COVID-19 cases, ARR) between 2019 and 2020 was calculated for each of the included studies. Correlation between ARR and number of COVID-19 cases/100 000 population was evaluated using Pearson moment correlation equation. Statistical calculations were performed using SPSS V.22 (IBM).

RESULTS

A total of 40 studies were included in this analysis. They demonstrated a reduction of 28.1% in rates of admission in patients with ACS during the COVID-19 pandemic period compared with the same period in 2019 (total of 28 613 patients in 2020 vs 39 225 patients in 2019) (table 1) figure 2. (figure 3)

Only 16 studies provided a subgroup analysis for ACS which in total demonstrated a reduction in cases admitted in 2020 compared with that of 2019 with a 21.9% reduction in STEMI cases (9374 vs 11 839 patients, respectively), 27% reduction in NSTEMI (10 855 vs 14 671 patients, respectively) and 48.1% reduction in the number of patients admitted with UA (343 vs 545 patients, respectively) (figure 4).

There was a positive correlation between the ARR in the total number of ACS cases and the number of COVID-19 cases per 100 000 population in published

Table 1 Details of the enrolled studies showing the number of ACS cases admitted during 2019 and 2020

Study	Country	Observation period	2019				2020			
			ACS	STEMI	NSTEMI	UA	ACS	STEMI	NSTEMI	UA
Zitelny <i>et al</i> ¹²	USA	1/1 to 31/3	104	104			103	103		
Solomon <i>et al</i> ²²	USA	1/1 to 14/4	1635				1504			
Braiteh <i>et al</i> ²³	USA	1/3 and 30/4	113	28	85		67	23	44	
Garcia <i>et al</i> ¹⁹	USA	1/1 to 31/3	611	611			550	550		
Gluckman <i>et al</i> ²⁴	USA	30/12 to 16/5	2664				2506			
Lotfi <i>et al</i> ²⁵	USA		1092				1038			
Coughlan <i>et al</i> ²⁶	Ireland	27/3 to 17/4	14	14			9	9		
Wilson <i>et al</i> ²⁷	UK	19/2 to 14/4	388	388			199	199		
Griffin ²⁸	UK	15/2 to 31/3	1888	621	1267		1210	477	733	
Mafham <i>et al</i> ²⁹	UK	1/1 to 24/5	39 225				28 613			
Papafaklis <i>et al</i> ⁸	Greece	1/1 to 12/4	1077	327	479	271	771	247	352	172
Oikonomou <i>et al</i> ¹⁰	Greece	9/3 to 12/4	141	45	96		60	21	39	
Piccolo <i>et al</i> ³⁰	Italy	30/1 to 26/3	1621	724	897		1093	489	604	
De Filippo <i>et al</i> ⁴	Italy	1/1 to 31/3	765				547			
De Rosa <i>et al</i> ³¹	Italy	12/3 to 19/3	618	268	350		319	197	122	
Di Liberto <i>et al</i> ³²	Italy	1/3 to 25/4	46	46			26	26		
Secco <i>et al</i> ¹¹	Italy	1/3 to 31/3	162	66	93	3	84	49	33	2
Toniolo <i>et al</i> ¹⁶	Italy	1/3 to 31/3	71	21	32		34	10	6	
Trabattoni <i>et al</i> ²¹	Italy	8/3 to 10/4	19	10	9		68	46	22	
Vecchio <i>et al</i> ³³	Italy	9/3 to 9/4	49	49			31	31		
Cammalleri <i>et al</i> ³⁴	Italy	1/3 to 31/3	35	35			13	13		
Kessler <i>et al</i> ¹⁷	Germany	1/3 to 30/4	3411	677	2584		2509	510	1911	
Schwarz <i>et al</i> ³⁵	Germany	1/1 to 19/4	180	50	64	69	101	34	51	16
Gitt <i>et al</i> ³⁶	Germany	1/1 to 21/4	502	103	197	202	425	118	154	153
Scholz <i>et al</i> ³⁷	Germany	1/1 to 31/3	443	443			387	387		
Seiffert <i>et al</i> ²⁰	Germany	1/1 to 31/5	11 032	3350	7682		9458	2940	6518	
Claeys <i>et al</i> ¹⁸	Belgium	13/3 to 3/4	260	260			188	188		
Daoulah <i>et al</i> ³⁸	Saudi Arabia	1/1 to 30/4	635	635			500	500		
Félix-Oliveira <i>et al</i> ¹⁵	Portugal	1/3 to 31/3	28	28			12	12		
Gąsior <i>et al</i> ¹³	Poland	9/3 to 16/4	2524				1424			
Hauguel-Moreau <i>et al</i> ³⁹	France	17/2 to 26/4	107	63	44		37	16	21	
Lantelme <i>et al</i> ⁴⁰	France	1/1 to 5/4	142				98			
Rangé <i>et al</i> ⁴¹	France	1/1 to 14/4	693	693			615	615		
Romaguera <i>et al</i> ⁴²	Spain	1/1 to 19/4	524				395			
Tam <i>et al</i> ⁴³	China	17/2 to 26/4	107	63	44		37	16	21	
Toner <i>et al</i> ⁷	Australia	16/3 to 15/4	102				20	3	17	
Li <i>et al</i> ⁸	Taiwan	1/2 to 30/4	1092	1092			1038	1038		
Sharif Khan <i>et al</i> ⁴⁴	Pakistan	23/3 to 7/5	621	621	748		386	386	207	
Khalil <i>et al</i> ⁴⁵	Turkey	10/3 to 30/4	404	404			121	121		
Butt <i>et al</i> ⁴⁶	Qatar	1/3 to 31/3	171				114			

ACS, acute coronary syndrome; NSTEMI, non-ST-elevation myocardial infarction; UA, unstable angina.

each country (Pearson correlation=0.361* (p=0.028)) (figure 5).

However, the correlation was not significant for each of the ACS subgroups: non-STEMI (p=0.508), STEMI (p=0.883), and UA (p=0.175).

DISCUSSION

The emergence of Coronavirus SARS-CoV-2 in Wuhan, China in December 2019 has led to global healthcare system changes. One of which is the number of patients admitted in hospitals including ACS cases. How COVID-19

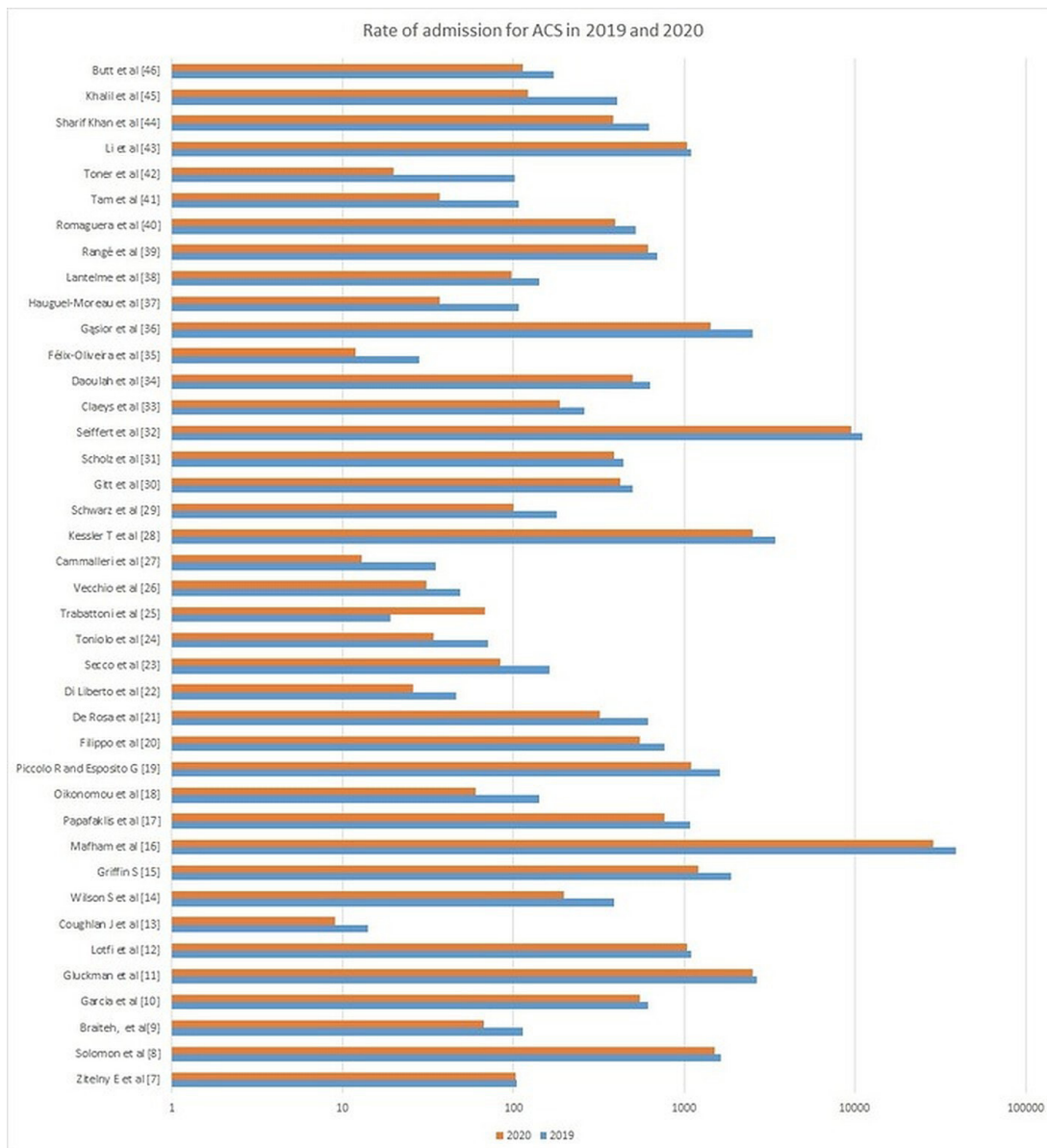


Figure 2 Rate of admissions with acute coronary syndrome (ACS) across all papers included.

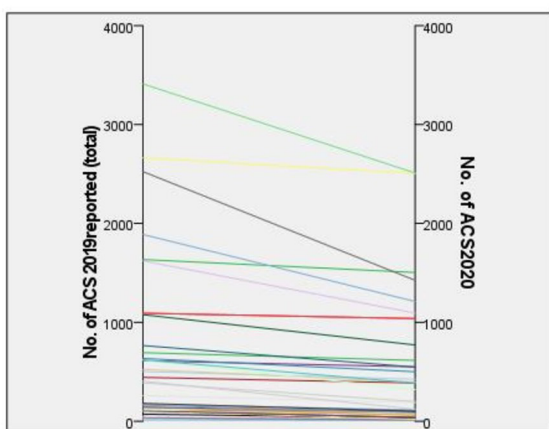


Figure 3 The number of acute coronary syndrome (ACS) admissions in 2019 and 2020 in each study.

is affecting admissions and management of myocardial infarction is a matter of concern, as medical resources have been massively reorientated, and the population has been in lockdown.

Nearly all studies reported a decrease in ACS cases except for two studies undertaken in Australia and Taiwan where early measures were taken to limit the virus spread.^{7 8} However, in Greece where similar early precautions were implemented, there was still a significant reduction in admissions recorded as well.^{9 10}

Some viral illness, like SARS-CoV and MERS-CoV, was noted to increase in acute cardiovascular events rate in infected patients. Similar effect was expected in patients with SARS-CoV-2 infections who also develop general proinflammatory and hypercoagulable status, explaining the frequent in-hospital acute coronary events observed.¹¹ The paradoxical phenomenon of decline

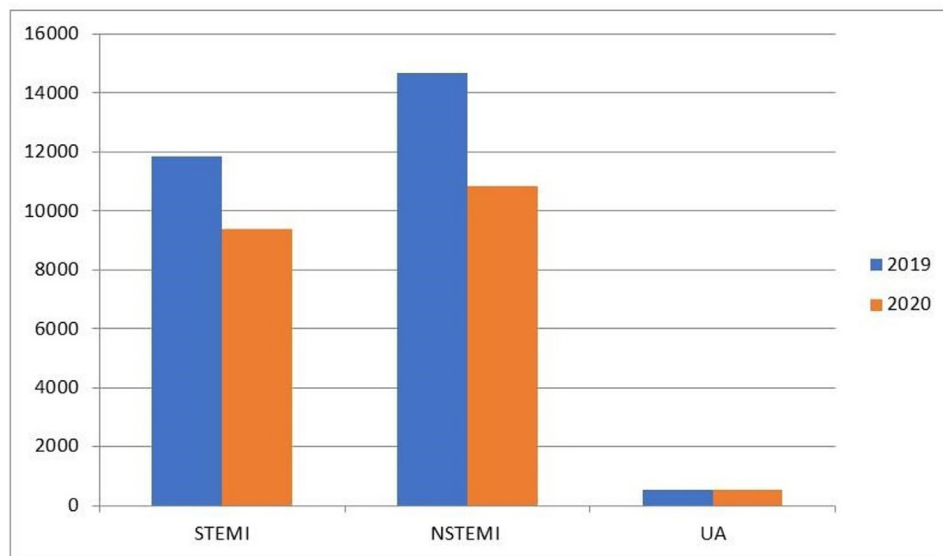


Figure 4 Comparison between the number of admissions with STEMI, NSTEMI and UA in 2019 and 2020. NSTEMI, non-ST-elevation myocardial infarction.

was observed after the first disease outbreak news from the WHO had been issued 5 January, 2020 and by the beginning of nationwide lockdowns, suspension of elective procedures and precautionary stay at home measures following declaration of COVID-19.¹² These measures, however, helpful in reducing the diffusion of SARS-CoV-2 infection, significantly modified patients' responses to non-SARS-CoV-2 medical conditions, including ACS. Whether this decrease was due to the lockdown measures implemented, fear of Hospital transmission or decrease in stressors and environmental pollution and triggers for ACS remains to be investigated.

There have been suggested reasons for the decline of ACS admissions; however we do not have any data to say which were more important. Avoidance of hospitals and adherence to social distancing recommendations might be one of the important causes since the highest decline was observed mainly in the early weeks of the pandemic in most countries as well as the positive correlation we identified between the burden of COVID-19 cases and the absolute reduction in ACS cases. Even though the reduction was still found in countries spared by COVID-19 infection or where the infection was minimal,^{9 13} the inability to find transportation to hospitals and the overwhelming

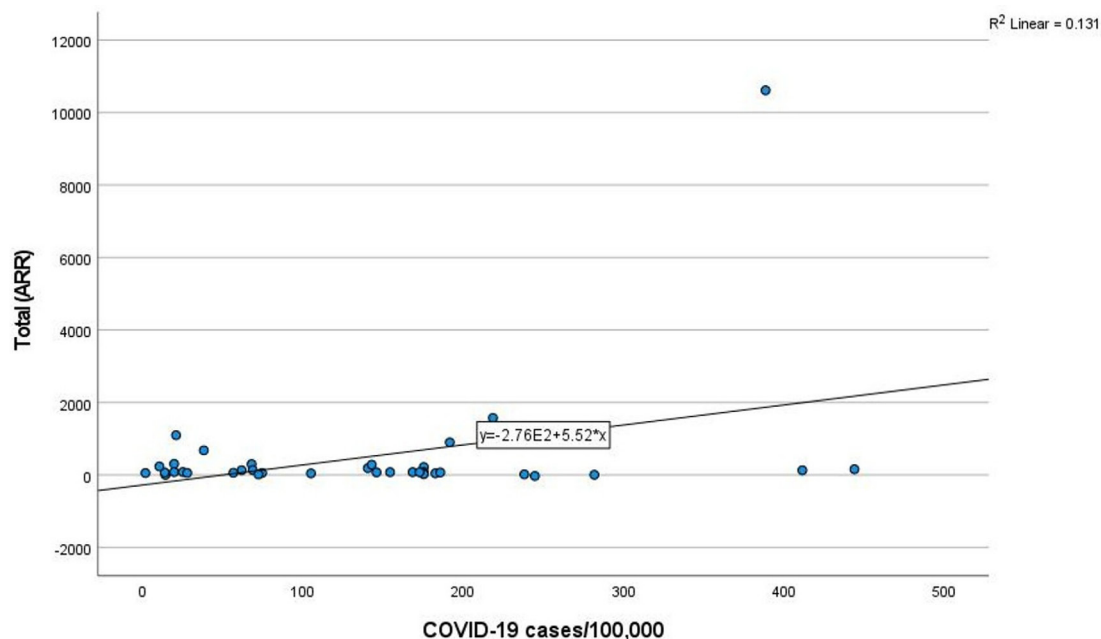


Figure 5 The correlation between Absolute risk reduction (ARR) of acute coronary syndrome admissions and the published number of COVID-19 cases in each study.

of healthcare systems remains a vital reason in most countries.

Globally, minimising symptoms, reluctance and fear of reaching out to hospitals expressed by delays in symptom to hospital times for fear of infection is probably the cause in many cases; driven by overwhelming messages from authorities and the media about COVID-19, especially that the reduction for ACS types with less severe clinical presentation/symptoms (ie, NSTEMI and UA) was more pronounced. Although an increase in out of hospital cardiac arrest, mortality,^{14 15} complications and more frequent left ventricle systolic impairment¹⁶ were observed, no correlation has been established so far and this link was denied in some countries^{10 17} and the correlation might be hard to establish.

However, a reason which causes worry might be misdiagnosis and underdiagnosis by doctors who are COVID-19 minded along with overstretched healthcare system since it was emphasised from the very beginning that dyspnoea and chest discomfort were the dominant symptoms of the viral infection, which obviously could be misleading for many patients with ACS.

In Belgium, a decrease in pollution and lower levels of NO₂ was found have contributed to a true decrease in ACS cases.¹⁸ Other factors suggested are the decrease in physical strain, sympathetic activity and change in diet, less smoking, more adherences to medications, sleep time and reduced common stressors known to cause ACS most notably in the early phases of the lockdown. These factors started to decline in the later weeks due to increased anxiety because of financial insecurity,¹⁹ relative liberation of social restriction measures²⁰ as well as increased encouragement of patients with symptoms or signs of ACS to seek immediate medical attention.²¹

The consequences of this decline of ASC admissions could have a detrimental impact on ACS outcome in terms of increased myocardial impairment, mortality and morbidity. The later can represent a challenge to the cardiology community after the marked reduction in ACS complications in the past decade.

CONCLUSION

A total of 40 studies from different countries all over the world have shown a reduction in rates of admission in patients with ACS during the COVID-19 pandemic period compared with the same period in 2019, with a positive correlation with the published figure of COVID-19 infection.

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