

Responses of a Pre-hospital Emergency Medical Service During Military Conflict Versus COVID-19: A Retrospective Comparative Cohort Study

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ABSTRACT

Background:

Decreases in routine healthcare practices have been shown to occur during disasters. However, research regarding the impacts of natural disasters, pandemics, or military conflicts on emergency medical services (EMS) is scarce.

Objectives:

This study assessed the impact of a military conflict versus the coronavirus disease 2019 (COVID-19) pandemic on a national EMS organization in terms of responses to overall daily emergencies, medical illnesses, motor vehicle collisions, and other injuries.

Methods:

This retrospective comparative cohort study assessed daily routine emergency ambulance calls to Magen David Adom (MDA), Israel's national EMS organization. This included overall emergency calls as well as those related to medical illnesses, motor vehicle collisions (MVCs), and other injuries. All data were obtained from the MDA command and control database. During the military conflict Operation Protective Edge (2014), the civilian population was subjected to intensive rocket attacks for 24 days, followed by 26 days of a progressive withdrawal of operations and then to a post-conflict period. During the first wave of the COVID-19 pandemic (March-April 2020), the population was subjected to 32 days of total lockdown, followed by 27 days of progressive relief of confinement, and then to a post-lockdown period.

Results:

The total number of emergency calls in this study was 330,430. During the conflict, the mean number of daily calls decreased, followed by an increase during Relief and Post-Conflict with higher values in Post-Conflict than in Pre-Conflict. During the COVID-19 pandemic, there was a decrease in the mean daily number of calls during Lockdown. It remained low during Relief and increased during Post-Lockdown. However, it remained lower in Post-Lockdown than during Pre-Lockdown. Calls related to medical illnesses decreased during the conflict and during the lockdown. The post-conflict period was characterized by a similar baseline call magnitude but not during the post-lockdown period. Decreases in calls for MVC and other injuries were significant during the lockdown but not during the military conflict. Post-lockdown was accompanied by return to baseline call volumes for MVC, whereas calls for other injuries increased above baseline both after the lockdown and military conflict.

Conclusion:

This study shows decreasing trends in routine daily calls for EMS during both Operation Protective Edge and COVID-19. However, different patterns of needs for EMS were evidenced for medical illnesses, MVC, or calls concerning other injuries. These results are instrumental for managing the operational demands of EMS during military conflicts and pandemics.

INTRODUCTION

Whenever a major disaster occurs, emergency medical services (EMS) must balance the needs created by the crisis with

the ongoing needs of everyday emergencies. Disasters disrupt the routine and cause a level of suffering that exceeds the capacity of adjustment of the affected community. They are routinely divided into natural or man-made. Recent experiences from major natural catastrophes such as earthquakes and hurricanes have been reported.¹⁻³ Even though they point out the importance of the preparedness of the health system, they surprisingly report decreases in hospital workload during the occurrence of the disaster. A significant reduction in emergency department (ED) visits was noted on the day of the landfall of Hurricane Isabel,² and the lowest monthly total visits to EDs were reported in the month immediately following Hurricane Katrina.³

In Israel, like other places around the world, war-related emergencies have been studied within the battlefield in the

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military context. The civilian aspects of war-related emergencies have been scarcely addressed. An 18% reduction in the overall workload on the EDs of hospitals and a 50% decrease in ambulatory family practice were reported after Scud missile attacks during the 1991 Gulf war.^{4,5} More recently, prolonged rocket attacks during the Second Lebanon War (2006) led to a 40% decrease from normal occupancy in a major medical center in northern Israel.⁶

During military conflicts and subsequent rocket attacks, Israeli cities are used to coping with repetitive disruptions in the daily life of the residents. But as in many other countries, the ongoing severe acute syndrome coronavirus 2 (SARS-CoV-2, coronavirus disease 2019 (COVID-19)) pandemic hit Israel, and massive efforts were made, including social distancing and lockdowns, to mitigate and contain the disease.

During routine times, EMS provides the pre-hospital response for patients with acute illnesses or injuries. Disasters by definition carry the potential of overwhelming the capabilities of even the most competent medical system. Even though decreases in routine medical or surgical practice have been reported during military conflicts or disasters, the precise impact on EMS is not known.²⁻⁶ The objective of this study is to compare the changes in volume and nature of emergency calls to a national EMS organization during two types of extreme life-threatening situations: a military conflict versus a pandemic.

METHODS

Magen David Adom (MDA) is Israel's National EMS Organization and is an official member of the International Federation of Red Cross and Red Crescent Societies. Magen David Adom utilizes a fleet of over a thousand ambulances (including those equipped with basic life support and others with advanced life support equipment) spread throughout the country in 177 stations that are staffed by 2,500 employees and over 25,000 volunteers.⁷ Magen David Adom responds to thousands of calls daily via the nationally designated medical emergency number 1-0-1. In both standard and large-scale events, MDA operates as the primary source of dispatch, triage, treatment, and transport. Magen David Adom uses a sophisticated technological command-and-control platform that allows rapid intake, telephone guidance, auditing, archiving, automatic ambulance dispatch and automatic mobilization of volunteer first responders.⁸ This allows for centralized on-scene organization and subsequent data collection and post hoc analysis. For this study, an aggregate EMS calls census was undertaken using only retrospective de-identified data extracted through the institutional Business Intelligence System from the command-and-control platform of MDA.

Study Design

This retrospective comparative study assessed data regarding daily emergency calls to Israel's National EMS before, during, and after the military conflict "Operation Protective

Edge" (OPE, July-August 2014) and the first COVID-19 pandemic-related total lockdown (March-April 2020).

During OPE (July 7-August 26, 2014), intense rocket bombing on Israeli cities was followed by a period of progressive relief beginning on August 1, 2014, before return to everyday life.⁹ The military conflict was divided into four periods:

- Pre-Conflict (37 days, June 1-July 7, 2014)
- Conflict (24 days, July 8-July 31, 2014)
- Relief (26 days, August 1-August 26, 2014)
- Post-Conflict (35 days, August 27-September 30, 2014)

During the first wave of COVID-19 in Israel, the pandemic-related spread of cases led the Israeli government to enforce a 32-day lockdown followed by a slow and progressive period of easing of restrictions before return to re-opening of schools and workplaces.¹⁰ The present study of COVID-19-related events comprises four periods:

- Pre-Lockdown (78 days, January 1-March 18, 2020)
- Lockdown (32 days, March 19-April 19, 2020)
- Relief (27 days, April 20-May 16, 2020)
- Post-Lockdown (45 days, May 17-June 30, 2020)

It should be noted that the MDA Business Intelligence System required that data be extracted by entire month blocks, which resulted in unequal periods for OPE versus COVID-19.

Case Definition

Patient complaints were placed into general categories: medical illness or injury. Injuries were further subdivided into those due to motor vehicle collisions (MVCs) or to a series of other and non-specific causes of trauma (other injuries).

Daily numbers of calls in each category were monitored throughout the military conflict and the lockdown. Data were compared with that recorded during designated pre-event and post-event periods.

This study was approved by the Scientific Committee of MDA.

Statistical Analysis

The study was analyzed using descriptive statistics using the software ANALYSE-IT standard edition for Microsoft Excel. The Shapiro-Wilk test was used with a *P*-value of 0.05 to test the normal distribution of the data. Continuous variables were then presented as means with standard deviations if normally distributed or medians with interquartile ranges. Daily numbers of calls to MDA were assessed for every complaint and period. Differences in all parameters were tested using analysis of variance and subsequent Student's *t*-tests or Kruskal-Wallis and subsequent Wilcoxon-Mann and Whitney tests, as appropriate. Significance was defined as a two-sided alpha level of 0.05 (i.e., a *P*-value of less than 0.05 was considered significant).

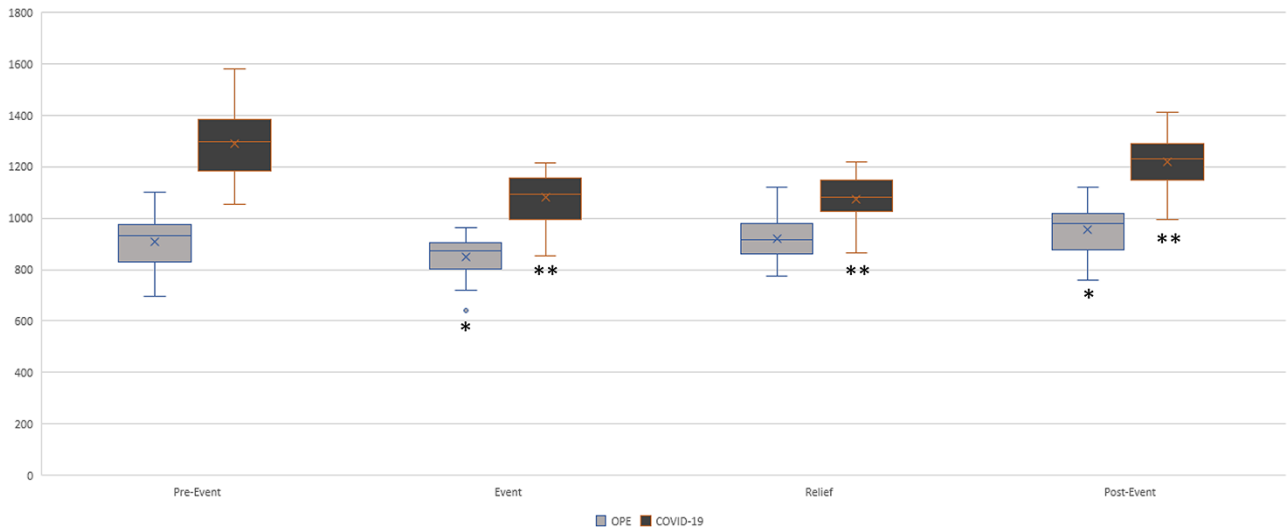


FIGURE 1. Mean total daily emergency calls to Magen David Adom (MDA) during Operation Protective Edge (OPE) and during coronavirus disease 2019 (COVID-19). Pre-Event is the period that precedes the occurrence of the relevant event, Event is the period during the event (military conflict or lockdown), Relief and Post-Event are periods following the event. *Statistically different from Pre-Event OPE; **statistically different from Pre-Event COVID-19.

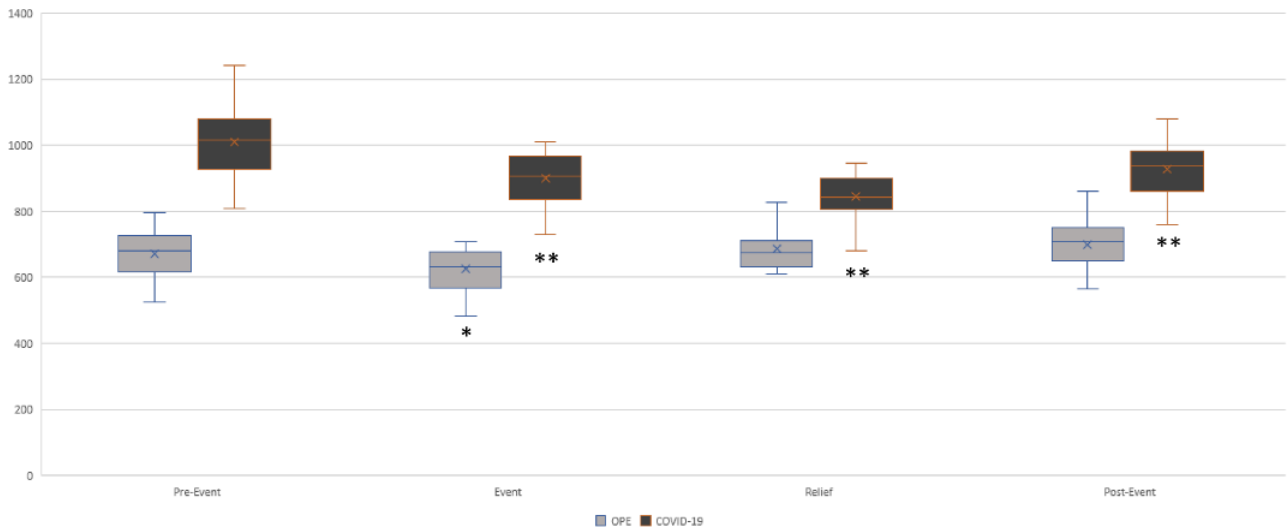


FIGURE 2. Mean daily emergency calls to Magen David Adom (MDA) for illness-related reasons during Operation Protective Edge (OPE) and during coronavirus disease 2019 (COVID-19). Pre-Event is the period that precedes the occurrence of the relevant event, Event is the period during the event (military conflict or lockdown), Relief and Post-Event are periods following the event. *Statistically different from Pre-Event OPE; **statistically different from Pre-Event COVID-19.

RESULTS

The total number of emergency calls in this study was 330,430. The mean total daily numbers of emergency calls are displayed in Figure 1. During the Conflict, the mean number of daily calls decreased, followed by an increase during Relief and Post-Conflict with higher values in Post-Conflict than in Pre-Conflict. During the COVID-19 pandemic, there was a decrease in the mean daily number of calls during Lockdown. It remained low during Relief and increased during Post-Lockdown than during Pre-Lockdown (Fig. 1).

Illness-related calls comprised 77% of the total. During OPE (Fig. 2), there was a significant decrease in the daily number of illness-related calls during the Conflict, with subsequent normalization during Relief and no difference between Relief and Post-Conflict. During COVID-19, there was a decrease in illness-related daily calls during Lockdown, followed by a further decrease during Relief, and a slight albeit significant increase during Post-Lockdown as compared with Relief. The number of daily illness-related calls remained lower in Post-Lockdown than in Pre-Lockdown (Fig. 2).

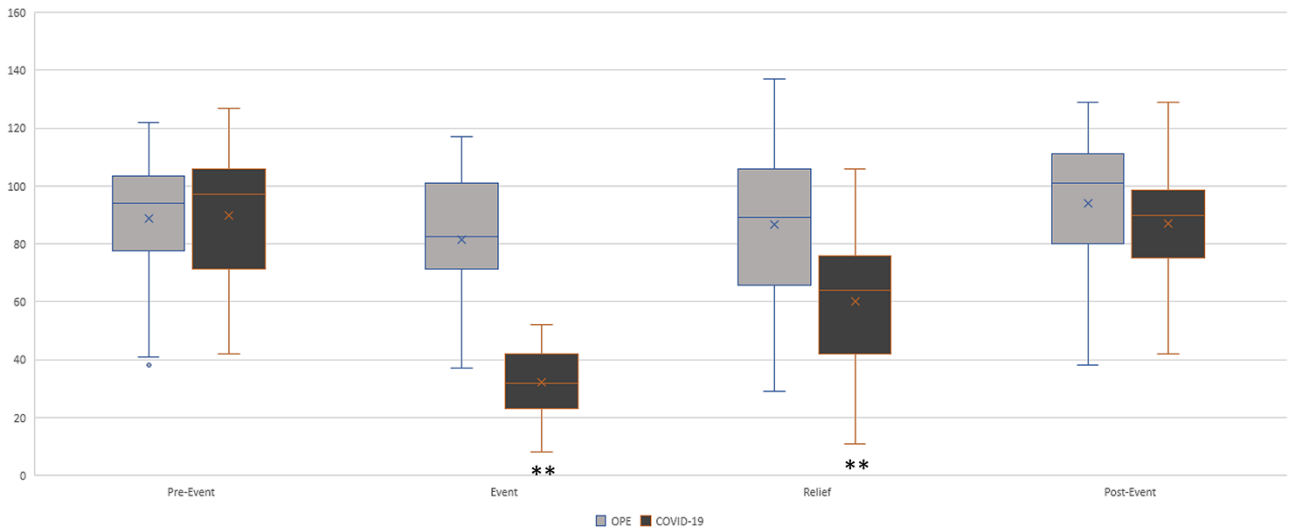


FIGURE 3. Mean daily emergency calls to Magen David Adom (MDA) for motor vehicle collisions during Operation Protective Edge (OPE) and during coronavirus disease 2019 (COVID-19). Pre-Event is the period that precedes the occurrence of the relevant event, Event is the period during the event (military conflict or lockdown), Relief and Post-Event are periods following the event. **Statistically different from Pre-Event COVID-19.

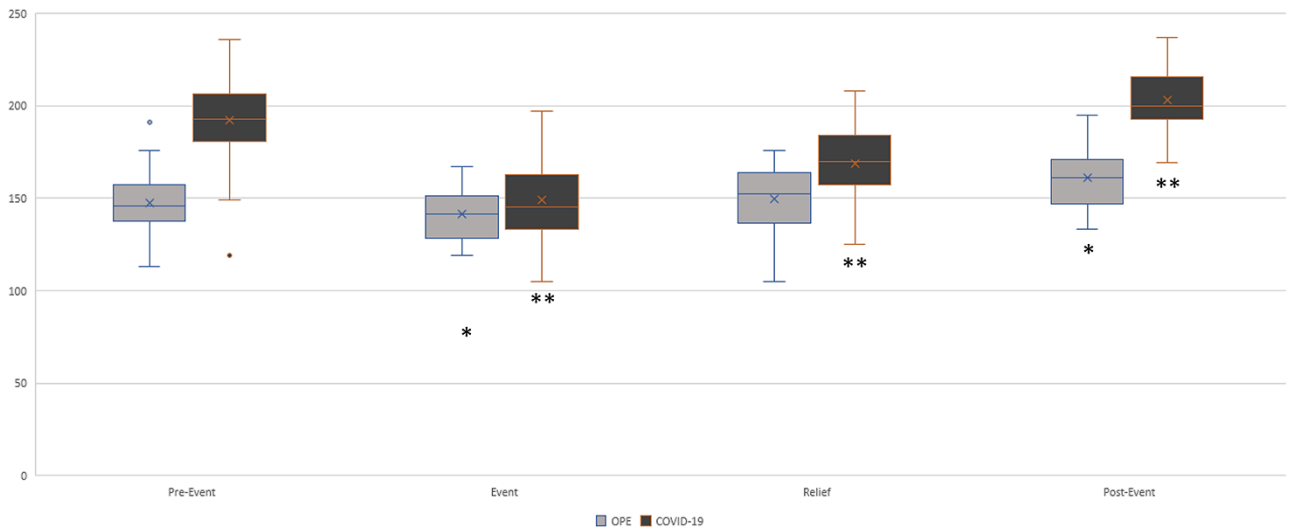


FIGURE 4. Mean daily emergency calls to Magen David Adom (MDA) for other injuries during Operation Protective Edge (OPE) and during coronavirus disease 2019 (COVID-19). Pre-Event is the period that precedes the occurrence of the relevant event, Event is the period during the event (military conflict or lockdown), Relief and Post-Event are periods following the event. *Statistically different from Pre-Event OPE; **statistically different from Pre-Event COVID-19.

The number of MVC-related calls was 7% of the total. During OPE (Fig. 3), there were non-significant changes in daily calls for MVC. During COVID-19, a marked decrease (−64%) occurred in MVC-related calls during Lockdown. A partial increase was found afterward during Relief, and numbers of MVC-related calls finally returned to baseline values during Post-Lockdown.

The number of “Other Injuries” calls was 16% of the total. No change was found in daily calls for “Other Injuries” during the Conflict period of OPE (Fig. 4). An increase in calls for “Other Injuries” was evidenced during the Post-Conflict period, reaching values higher than during Pre-Conflict.

During COVID-19, a 25% decrease in “Other Injuries” was evidenced during Lockdown. It was followed by a slight and significant increase during Relief and even more during Post-Lockdown, reaching values higher in Post-Lockdown than in Pre-Lockdown.

DISCUSSION

This retrospective comparative study evidenced a decreasing trend of calls to EMS as a result of a military conflict and a pandemic-related lockdown. It also reports that changes in volumes of daily calls for medical care exhibit different trends during a military conflict versus a pandemic.

Successful management of a disaster on a national level requires the implementation of pre-existing plans to maintain organizational control and maximize chances of survival. Effective planning by EMS is highly dependent on the analysis of past data trends. Therefore, gathering data associated with rare, potentially catastrophic events is crucial for the preparedness for sudden-onset disasters. Experiences from natural disasters and of war-related conflict periods reported common trends in decreased hospital workload.²⁻⁶ However, it is not known how such events impact on health services at a national level. The purpose of this study was to analyze the response of a national EMS to two types of scenarios on the same population: military conflict versus a pandemic. The 2014 OPE conflict and 2020 COVID-19 pandemic thus offered the opportunity to study the stresses placed on pre-hospital EMS. To the best of our knowledge, this is the first report to address and compare operational data from EMS in response to a military conflict and a pandemic on a national level.

In line with previously reported data from EDs^{4,6} and ambulatory care facilities,⁵ the mean daily total numbers of calls were found to be lower both during OPE (-6.5%) and the pandemic-related lockdown (-16%). Similar decreases in volumes of calls for medical care during a military conflict were documented during the 1991 Scud missile attacks in Israel. A 50% drop in visits to ambulatory care facilities and a 19% fall in overall workload in the ED of a hospital were reported.⁵ Providing medical care under fire is a tremendous challenge.⁴ During 5 weeks of combat in 2006 in Israel, a hospital continued both routine and emergency medical care under near-daily rocket bombardment with reductions of 40% and 50% in ED and outpatient visits, respectively.⁶ An increase in anxiety symptoms has been suggested in these circumstances,^{11,12} with the population being preoccupied with coping with the war situation, which could lead to a reduction in visits for what they consider to be more trivial problems.⁵

Illness-related calls comprised more than three-fourth of total calls. This study showed decreased volumes of routine emergency calls for medical illnesses during both the OPE military conflict and pandemic-related lockdown. It is possible that individuals seeking medical care went to the hospital by themselves, without calling 1-0-1. This study is in line with other findings from hurricanes,^{2,3} the 2003 SARS outbreak,¹³ and the still ongoing pandemic.¹⁴ Regarding the COVID-19 pandemic, as the number of persons hospitalized increased due to the SARS-CoV-2 outbreak, reports from the United States,¹⁵ Italy,¹⁶ and, Austria¹⁷ suggested sharp decreases in the number of persons seeking emergency medical care for other reasons. These drops may be due to the fear and anxiety of being exposed to the virus in medical settings.¹⁸ Fear is one factor in avoidance of medical care, and during epidemics, such behaviors might also be associated with misconceptions about the severity of other diseases. Substantial increases in the number of avoidable cancer deaths

in England are expected as a result of diagnostic delays due to the COVID-19 pandemic in the UK.¹⁹

The reported decreases in numbers of calls for illness-related emergency medical care during OPE may be explained by residents' avoidance to leave home unless necessary, as patients might have stayed away from the hospital during these potentially dangerous periods. This suggests that life-threatening situations have altered the use of EMS and the ED by the public and that some persons could be delaying care for conditions that might result in additional morbidity or mortality.

Whereas decreasing trends in numbers of illness-related calls were found to be similar during an intense military conflict and pandemic-related lockdown, they were followed by opposite patterns of behavior after the event. As soon as there was a progressive cessation of the bombing (i.e., Relief period), the number of calls returned to normal. During the pandemic, MDA evidenced a decrease in the number of calls during the period of progressive relief of confinement. Afterward, there was only a small increase during the period of restoration of everyday life (Post-Lockdown), remaining lower than before the Lockdown period. This indicates that fear of exposure to the virus neither disappeared nor decreased after the end of the Lockdown as reported by Mantica et al.²⁰ Conversely, the fear regarding rocket attacks seems to recede rapidly or almost immediately, as previously shown, when military conflict intensity decreases in a population which is habituated to war.¹²

MVC-related calls represented around 7% of total daily calls in the present work. A sharp decrease in calls for MVC was evidenced during the COVID-19-related lockdown, as previously reported.¹⁴ This can easily be explained by less crowded roads during the total lockdown. However, the present study reports that volumes of calls for MVC did not change significantly during the conflict period. This is in contrast with previous findings reporting less road accidents and more seriously injured patients during the Persian Gulf War.²¹ It should be noted that the present data refer to calls to MDA originating from the entire country, while only the southern part of Israel was under missile range. Further analyses taking into account the localization of calls may help answer this question.

Emergency calls due to "other injuries" (i.e., non-specific injuries) represent approximately 16% of total daily calls to MDA. As evidenced for MVC calls, this study found that the number of calls for "other injuries" reasons did not change during the period of the military conflict. In contrast, a decrease in calls for "other injuries" was evidenced during the lockdown. This is in line with the decrease in calls for injuries previously reported during COVID-19-related confinement.¹⁴ Decreases in injuries during lockdown may be due to limitations placed on the population's work and leisure activities. But, as noted above, the pronounced decrease in calls for "other injuries" raises the question of delayed diagnosis and

self-medication for some, as suggested by Lazznerini et al.¹⁶ Furthermore, this study found that the decreased volume of calls for “other injuries” during the lockdown of COVID-19 was followed by an increase (above baseline) in the volume of calls during Post-Lockdown. This increase could result from delayed calls for medical care of injuries that had occurred during the lockdown. But this marked rebound in calls for medical care for injuries after the end of Lockdown may also reflect the difficulty with maintaining confinement for such a long time, with population behavioral fatigue related to these restrictive measures. People thus are eager and return to leisure and sports activities and may have pushed themselves too hard, too quickly instead of gradually to avoid injuries. A rebound in injury rate has indeed been reported in people returning to sports activities after months of sedentarism.²² Moreover, recent observations also reported an increased injury rate in professional soccer players during their return to competition following COVID-19-related confinement.²³ Similarly, an increasing trend in calls for “other injuries” was also found during recovery from OPE (Post-Conflict). In the absence of precise diagnostics regarding these calls, the reasons for the trauma rebound effect after the lockdown as well as after the conflict still remain unclear and probably largely multifactorial.

A limitation of this study may be that it examined trends but not specific motivation patterns. Understanding trends may allow devoting EMS resources to other activities such as home or drive-through testing,²⁴ vaccinations,²⁵ or even educational actions.²⁶ The retrospective nature of the analysis makes it difficult to assess associated bias and/or confounding factors. A prospective study was obviously not possible, but the present analysis did allow the possibility of formulating ideas about relationships between pandemics or conflicts and the management of EMS but not causation.

CONCLUSION

This retrospective comparative study confirms the decreasing trend of calls to EMS as a result of a military conflict or a pandemic-related lockdown. After the military conflict, number of calls increased during the relief period and even more in the post-conflict period, whereas number of calls decreased during the relief period of COVID-related lockdown and increased during post-lockdown. More specifically, decreased volumes of calls for illness reasons were found to return to baseline values after the end of the military conflict but not after the end of a lockdown period. Also, volumes of calls for injuries unrelated to MVC decreased during the pandemic lockdown but not during the military conflict. These calls increased above baseline after the end of the lockdown as well as after the end of the military conflict. This study shows that military conflicts have different impacts on the activity of EMS compared to pandemics. These results are instrumental for managing the future operational demands of EMS.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

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