



## Full moons are not associated with increases in emergency medical services (EMS) activations (911 calls) in the United States



The influence of a full moon in emergency medicine has been a common source of superstition for considerable time [1]. Localized quantitative studies, however, reveal the full moon has little effect on both patient volume and patient acuity. For instance, Coates et al. [2] studied trauma admissions at a single level one trauma center over one calendar year and found there was no correlation between full moons and the number of trauma admissions: they called the hypothesized link between trauma and full moons “a waning theory”. Thompson & Adams [3] investigated patient volume at a single hospital-based ED over four years and found there were no significant differences in patient visits, ambulance arrivals, or hospital admissions when comparing full moon periods and non-full moon periods. Chapman & Morrell [4] looked at data from all public hospitals in Australia to show patient presentations for dog bites do not increase on the full moon. Eisenburger et al. [5] discovered no relationship between lunar phases and the presentation of acute myocardial infarction or sudden cardiac death. Zargar et al. [6] tracked the presentation of trauma patients at three hospitals in Iran over the course of twelve months and found no significant increase in trauma patients during full moon days. More recently, Kong et al. [7] showed no correlation between full moons and admissions for penetrating trauma at a major trauma center in South Africa between 2012 and 2018. The purpose of this study was to determine whether a full moon is associated with increased EMS patient volume and acuity using a large and nationally-representative data source.

The National Emergency Medical Services Information System (NEMSIS) is a national-level database of EMS activations in the United States. We examined all months during the year 2019 to see if full moon periods were associated with significant increases in 911-initiated EMS activations (e.g. total number of calls) or increases in specific types of calls. We specifically chose 2019 because it was the last year before the onset of the COVID-19 pandemic, which has significantly affected EMS activations [8,9]. We defined a full moon period as a three-day period containing the full moon and computed the daily average number of EMS activations during that three-day period for each month. We compared the daily average number of EMS activations during that three-day period with the corresponding daily average for the three-day periods one week immediately before and one week immediately after. For example, if a month's full moon took place on a Wednesday, we looked at the three-day period from Tuesday to Thursday of that week and the same days the week immediately before and after. We utilized the same technique to determine if full moons are associated with increases in specific call types, including cardiac arrest, overdose, pregnancy-related emergencies, penetrating trauma (eg. stab wound or gun-shot wound), psychiatric emergency, traffic accident, and unspecified traumatic injury. We defined a significant increase as full moon periods having at least 20% more EMS

activations than the week immediately before and immediately after the corresponding full moon period.

In 2019, 8,415,412 EMS activations took place during either full moon periods or their respective comparison periods; approximately 33.00% (2,777,241) took place during full moon periods. Full moon periods had a daily average of 77,146 activations, and non-full moon periods had a daily average of 78,308 activations. No months in 2019 were associated with a significant increase in EMS activations during full moon periods when compared with control periods. In fact, full moon periods were associated with very-slight reductions in EMS activations in seven out of the twelve months studied. No months were associated with a significant increase in any of the complaint types when comparing full moon periods with non-full moon periods.

It may be reasonable to conclude that full moons do not affect the prehospital presentation of patients to EMS on a national level. Our data demonstrates this in several key ways. First, exactly one-third of EMS activations meeting inclusion criteria took place during full moon periods. Since each month had six days defined as non-full moon periods and three days of full moon periods, this result indicates parity between full moon and non-full moon periods. Second, full moon periods actually had a lower daily average number of EMS activations than non-full moon periods. Finally, no months in 2019 were associated with increases in EMS volume. This is a robust demonstration of there being no link between full moons and EMS volume and patient acuity, especially considering potential variations across both day-of-the-week and month-of-the-year. Our findings are consistent with many other studies that have de-linked hypothesized associations between the full moon and patient volume/acuity.

Although our approach allows for a nationally-representative examination of whether full moons affect EMS resource use, it is subject to several limitations. For one, full moons may be associated with significant increases in patient volume and patient acuity within specific communities but not nationally. Additionally, our study only includes patients who present to EMS. Full moons may be associated with increases in medical emergencies but these patients are not presenting to EMS because they are not seeking help or are presenting to the emergency care system in other ways (eg. walk-in to ED). This is unlikely given other literature. Finally, we arbitrarily defined a significant increase as full moon periods having at least 20% more activations than respective comparison periods. We did this because there is no widely-accepted standard for what constitutes a significant increase in EMS volume, and it is tough to determine what percentage increase translates into a noticeable change in provider workload. We had to choose a threshold high enough to function against random variations in EMS volume but low enough to be sensitive to potential associations between lunar phase and volume.

In conclusion, we found no evidence to suggest that the full moon has an effect on the pattern of EMS activations within the United States. Further studies should continue to attempt to challenge commonly-held misconceptions in medicine.

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None.

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**Credit authorship contribution statement**

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