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Laypeople's activity for seeking telephone number of EMS before and during the COVID-19 outbreak: An analysis of web search data



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ABSTRACT

Objective: To explore trends and patterns of laypeople's activity for seeking telephone number of emergency medical services (EMS) based on analysis of online search traffic, including changes of the search activity with onset of the coronavirus disease 2019 (COVID-19) outbreak, in five countries – the United States of America (USA), India, Brazil, the United Kingdom (UK) and Russia.

Methods: Google Trends (GT) country-level data on weekly relative search volumes (RSV) for top queries to seek EMS number were examined for January 2018–October 2021, including a comparison of RSVs between pre-COVID-19 period (January 2018–October 2019) and COVID-19 period (January 2020–October 2021), and evaluation of temporal associations of RSVs with weekly numbers of new COVID-19 cases.

Results: The countries demonstrated diverse patterns of the search activity with significantly different mean RSVs (the USA 1.76, India 10.20, Brazil 2.51, the UK 6.42, Russia 56.79; $p < 0.001$). For all countries excepting the USA mean RSVs of the COVID-19 period were significantly higher compared with the pre-COVID-19 ones (India +74%, Brazil +148%, the UK +22%, Russia +9%; $p \leq 0.034$), and exhibited positive correlations with numbers of new COVID-19 cases, more pronounced for 2021 (India $r_s = 0.538$, Brazil 0.307, the UK 0.434, Russia 0.639; $p \leq 0.045$).

Conclusion: Laypeople's activity for seeking EMS telephone number greatly varies between countries. It clearly responds to the spread of COVID-19 and could be reflective of public need for obtaining emergency help. Further studies are required to establish the role of GT for conducting real-time surveillance of population demand for EMS.

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1. Introduction

Early recognition of life-threatening health condition with prompt activation of emergency medical services (EMS) through a telephone call constitute the first vital link in the chain of survival – the sequence of time-sensitive interventions which are essential for improving outcomes in medical emergencies [1–3].

A number of population-based surveys showed variable percentages of laypeople knowing local emergency numbers in different countries [4–13], suggesting unequal extent of preparedness of the general public to react in acute health crises. However, no previous study has investigated activities of laypeople for seeking telephone number of EMS. Better understanding of this issue could help in improving engagement of the community in responding to life-threatening conditions and in tailoring response of EMS to population demand for emergency help.

This exploratory study aimed to examine trends and patterns of laypeople's activity for seeking telephone number of EMS based on analysis

of online search traffic data. Additionally, changes in the internet search volumes with onset of the coronavirus disease 2019 (COVID-19) outbreak were investigated, since it was hypothesized that the outbreak could amplify public demand for EMS and potentiate search of EMS number.

2. Materials and methods

The study involved five countries with the highest total numbers of confirmed cases of COVID-19 as of 1st November 2021 – the United States of America (USA; 46,146,485 cases), India (34,355,536), Brazil (21,862,458), the United Kingdom (UK; 9,272,070) and Russia (8,795,095) [14].

The study period ranged from January 2018 to October 2021. For comparison of the internet search activity before and after the onset of the COVID-19 outbreak two chronologically compatible periods were selected: January 2018–October 2019 (pre-COVID-19 period) and January 2020–October 2021 (COVID-19 period). January 2020 was selected

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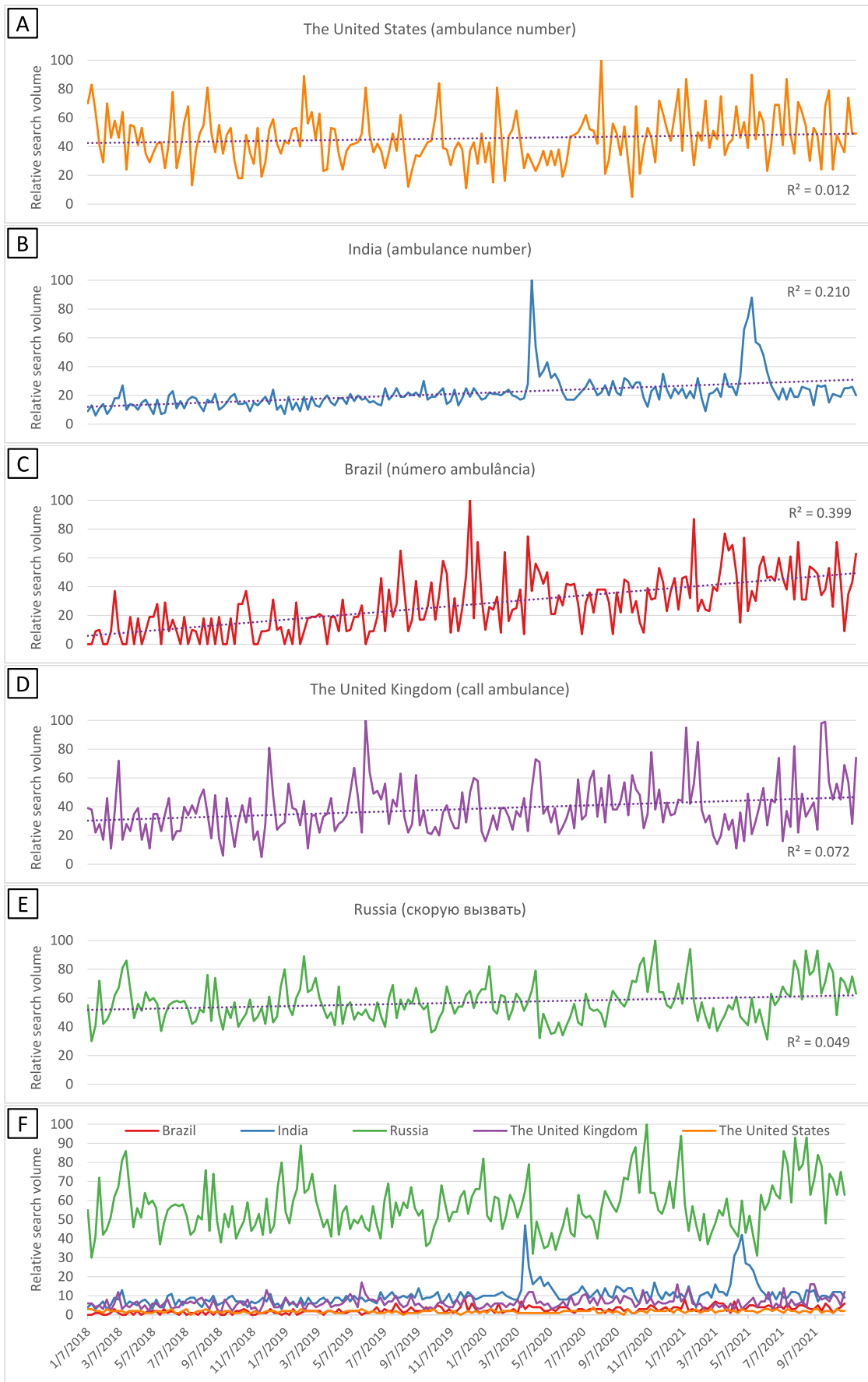


Fig. 1. RSV trends for EMS telephone number queries by country (panels A-E) and in GT between-country comparison (panel F) in 2018–2021. Note: An RSV value of 100 is the peak activity; other values are normalized relative to the peak. Dotted lines represent linear regression.

Table 1
GT between-country comparison of RSVs for EMS telephone number search requests at different time periods.

Country	Whole study period (2018–2021)		Pre-COVID-19 period (2018–2019)		COVID-19 period (2020–2021)	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
The USA	1.76 (0.69)	2.00 (1.00–2.00)	1.86 (0.68)	2.00 (1.00–2.00)	1.81 (0.72)	2.00 (1.00–2.00)
India	10.20 (5.67)	9.00 (7.00–12.00)	8.64 (2.54)	8.00 (7.00–10.00)	13.22 (6.85)	12.00 (9.25–14.00)
Brazil	2.51 (1.75)	2.00 (1.00–3.75)	1.59 (1.37)	1.00 (1.00–2.00)	3.60 (1.65)	3.00 (2.00–5.00)
The UK	6.42 (2.91)	6.00 (4.00–8.00)	6.78 (3.43)	7.00 (4.00–9.00)	7.28 (2.81)	7.00 (5.00–10.00)
Russia	56.79 (13.36)	55.00 (47.00–64.00)	59.24 (14.15)	57.00 (49.00–67.00)	55.84 (14.92)	55.00 (46.00–65.00)

Notes. IQR, interquartile range; SD, standard deviation; UK, United Kingdom; USA, United States of America.

as a start point for the latter period since first cases of COVID-19 were confirmed for the USA, India, the UK and Russia that month.

The web search traffic data were retrieved on 10th November 2021 using Google Trends (GT; Google LLC, USA) [15] – a free online tool that allows users to evaluate and track popularity of search requests. The popularity is presented as a relative search volume (RSV) that is calculated as amount of queries for the user-specified search term relative to all Google searches performed in a certain location and time period. RSVs are indexed from 0 to 100, where 100 indicates the peak popularity and other values are normalized relative to the peak [15].

First, the GT search topic “Ambulance” was examined using “related queries” feature of GT [16] to reveal most popular country-specific queries for seeking telephone number of EMS. The following top terms were detected: the USA and India – “ambulance number” (English), Brazil – “número ambulância” (Portuguese for “ambulance number”), the UK – “call ambulance” (English), Russia – “срочно вызвать” (Russian for “call ambulance”). Then, databases of RSVs were generated for these search queries by country and downloaded for statistical analysis, including analysis of temporal associations between RSVs and weekly numbers of new COVID-19 cases (gathered from the World Health Organization COVID-19 Dashboard [14]).

Statistical analysis was carried out using IBM SPSS Statistics 26 (IBM Corporation, USA), and involved descriptive statistics, Mann–Whitney U test, Wilcoxon test, Spearman’s correlation coefficient and linear regression. A two-tailed p -value of <0.05 was considered statistically significant.

3. Results

Temporal trends of RSVs for EMS telephone number search requests between 2018 and 2021 are shown by country and in GT between-country comparison on Fig. 1, and descriptive statistics of the between-country comparison are presented in Table 1.

The countries under study had diverse patterns of the search activity, and the RSVs did not show any seasonality.

The GT between-country comparison for the whole study period, pre-COVID-19 and COVID-19 periods (Table 1) revealed statistically significant differences of RSVs among the countries ($p < 0.001$), excepting the USA vs. Brazil in the pre-COVID-19 period ($p = 0.051$).

Regression analysis demonstrated a trend for increase in RSVs from 2018 to 2021 for India ($p < 0.001$), Brazil ($p < 0.001$), the UK ($p < 0.001$), Russia ($p = 0.002$), but not for the USA (Fig. 1).

Table 2

GT country-level comparison of RSVs for EMS telephone number search requests between the pre-COVID-19 period and the COVID-19 period

Country	Pre-COVID-19 period (2018–2019)		COVID-19 period (2020–2021)		p -value
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	
The USA	44.56 (16.26)	42.00 (35.00–53.00)	47.73 (18.50)	47.00 (35.00–57.00)	0.217
India	15.74 (4.86)	16.00 (13.00–19.00)	27.33 (14.42)	24.00 (20.00–29.00)	<0.001
Brazil	15.56 (14.13)	12.00 (0.00–19.00)	38.53 (17.07)	37.50 (26.00–48.50)	<0.001
The UK	34.72 (15.94)	34.00 (23.00–45.00)	42.31 (18.70)	38.00 (29.00–52.00)	0.005
Russia	54.35 (11.32)	53.00 (46.00–60.00)	59.00 (15.24)	57.50 (48.00–67.25)	0.034

Notes. IQR, interquartile range; SD, standard deviation; UK, United Kingdom; USA, United States of America.

RSVs of the COVID-19 period were significantly higher compared with the pre-COVID-19 ones for all countries excepting the USA (Table 2).

In the COVID-19 period, the RSVs exhibited statistically significant positive correlations with weekly numbers of newly diagnosed COVID-19 cases for India (Spearman’s correlation coefficient (r_s) = 0.251; $p = 0.014$), Brazil ($r_s = 0.265$; $p = 0.010$), the UK ($r_s = 0.266$; $p = 0.009$), Russia ($r_s = 0.368$; $p < 0.001$) and the USA ($r_s = 0.205$; $p = 0.047$) (Fig. 2). Separate analysis for the year 2021 revealed stronger correlations: India ($r_s = 0.538$; $p < 0.001$), Brazil ($r_s = 0.307$; $p = 0.045$), the UK ($r_s = 0.434$; $p = 0.004$), Russia ($r_s = 0.639$; $p < 0.001$). For the USA the 2021 analysis did not show statistically significant correlation ($p = 0.410$).

4. Discussion

This exploratory study found that internet search traffic related to seeking telephone number of EMS had individual national patterns and significantly varied between the countries, where Russia had the highest and the USA had the lowest average search volume with about 32-fold difference.

It is probable that the substantial between-country differences in RSVs are resulting from unique complex combinations and uneven balance of factors that drive laypeople’s behavior for seeking EMS number, including extent of demand for EMS, real availability of EMS for a population, as well as actual knowledge of EMS telephone numbers among the general public. However, lack of research on this subject complicates further interpretation. In particular, published data on percentages of population who knew EMS telephone number in the studied countries are limited to results of several surveys conducted at varying times on a sub-national level [4,7,13,17], whereas national-level data are lacking.

The current study shed some light on one of the drivers of the EMS number seeking behavior, namely on the demand for EMS. In all studied countries excepting the USA the average volume of online search for EMS telephone number significantly increased with the onset of the COVID-19 outbreak. Further, extent of the web search had clear positive correlation with quantity of new cases of COVID-19, and the correlation was stronger in 2021 compared with the 2020–2021 period, presumably due to higher availability of COVID-19 testing, and consequently more accurate estimation of incidence of the disease in 2021.

The correlation suggests that laypeople’s activity for seeking telephone number of EMS responds well to the outbreak surges, thus



Fig. 2. RSV trends for EMS telephone number queries by country in the COVID-19 period (2020–2021). Note: RSV values are normalized relative to the peak value of the whole study period (2018–2021). Dotted lines represent weekly numbers of new COVID-19 cases.

probably reflecting population demand for EMS. Hence, continuous monitoring and geographic mapping of the GT data on a national and a sub-national level could help to detect trends and spikes of general public's demand for EMS and to promptly inform decision makers on how to adjust managerial strategies to optimally allocate EMS resources and accommodate to rapidly changing demand of the population for seeking emergency help.

Interestingly, in the USA the RSVs for EMS telephone number search did not show significant increase after the onset of the COVID-19 outbreak and did not correlate with weekly quantities of new COVID-19 cases, whereas dramatic increases in EMS call volumes over the course of the COVID-19 outbreak were reported for this country [18]. A possible explanation might be a high percentage of US population who know the national EMS telephone number (911), that was reported as high as 90% as far back as 1985 [4].

5. Limitations

Results of this preliminary study must be interpreted bearing in mind the limitations inherent to infodemiologic research conducted with GT [19,20], including use of normalized nonabsolute data and restriction of the population to those having access to internet and utilising Google search engine. Further work is needed to fully understand potential implications of using GT to track and analyze laypeople's behavior for seeking EMS help.

6. Conclusions

Public activity for seeking telephone number of EMS online has individual national landscapes, and volume of the search greatly varies between countries. The ongoing COVID-19 pandemic stimulates the EMS number seeking behavior among the general public, and positive correlation of the search activity with numbers of newly diagnosed COVID-19 cases suggests it could reflect changes in public demand for EMS. More research is necessary to determine the utility of GT for conducting real-time monitoring of population demand for emergency help.

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Declaration of Competing Interest

The author declare no conflicts of interest.

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