COVID-19’s impact on interest in gastrointestinal topics

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Abstract
There has been a disparity in familiarity regarding the public interest in gastroenterology terminologies during the COVID-19 pandemic. This study aimed to understand the outcomes of the public’s view on gastrointestinal topics and their potential social effects. This study is a comparative analysis of American Google Trends gastrointestinal terminology during the COVID-19 pandemic compared to a similar time frame (March 2018-February 2020) to determine how trends in the patient-seeking behavior of gastrointestinal terminology changed throughout the pandemic. The analysis discovered a substantial decrease in search volumes of gastrointestinal topics, more significantly in the first pandemic months. Later in the pandemic, search volumes trended toward pre-pandemic years in terms of public interest. In the case of gastrointestinal procedures, endoscopy and colonoscopies, they surpassed pre-pandemic interest levels statistically ($p$-values of 0.01 and 0.002). The public’s decreased interest in gastrointestinal topics at the beginning of the COVID-19 pandemic may have adverse effects on the healthcare maintenance of patients who could have had a positive outcome in their gastrointestinal health with proper monitoring. Although gastrointestinal internet searches increased toward pre-pandemic levels as the seasons progressed, further research is needed to determine the social impact of decreased public interest.

Keywords Infodemiology · Health services · Gastrointestinal · COVID-19 · Google Trends · Epidemiology

Introduction
The coronavirus 2019 disease (COVID-19) pandemic has imposed unprecedented changes on people’s daily lives. Since national lockdowns were issued in March 2020, an added emphasis has been placed on the COVID-19-related health issues. In addition, the public experienced a new way of living during the pandemic to reduce COVID-19 transmission. In a paper published by Mario Coccia (2021), evidence suggests that increasing social distancing and reducing individuals’ mobility to participate in events they previously attended could mitigate the diffusion of COVID-19 in society. “Superspreader” locations where many people gather, such as fitness centers and restaurants, were the source of many COVID-19 transmissions. While these abrupt changes have had a profound impact on contracting the disease, these changes, compounded by new healthcare administration protocols, have impacted the public’s interest in non-COVID-19-related health issues.

Google Trends is an internet tool used to determine geographical and time-based Google search trends for keywords (Eysenbach 2006). It has been utilized as a valuable resource in determining public interest in different medical
fields such as dermatology (Kutlu 2020), pediatric neurosurgery (Güdük et al. 2021), musculoskeletal disease (Kardeş et al. 2021), and mental health (Becerra-García et al. 2021). Google Trends is the most popular online tool to address medical research (Mavragani and Ochoa 2019).

Unfortunately, there is limited information on patient search interest in gastrointestinal health during the COVID-19 pandemic. This lack of interest likely has caused some individuals to neglect their health. For example, there has been an increase in alcohol consumption and the adoption of unhealthy lifestyles due to lockdowns during the pandemic. A rise in alcohol use is a risk factor for many gastrointestinal diseases including liver and colonic diseases. Because of this, gastrointestinal health should be emphasized and closely monitored by healthcare professionals, especially in these vulnerable populations (Pakhchanian et al. 2021). In addition to alcohol-related gastrointestinal diseases, this manuscript shows an initial lack of interest in gastrointestinal procedures, suggesting a delay in appropriate gastrointestinal cancer screenings. This could affect society with future spikes in gastrointestinal cancer diagnosis. Therefore, the main aim of this study is to correlate the American public interest in gastrointestinal topics during the COVID-19 pandemic by utilizing Google Trends to see how it can affect the future environment of gastrointestinal health.

Materials and methods

Sample and data

This study sample is the collective data of search volumes in the USA extracted from Google Trends.

Measures of variables

This manuscript’s main variables are relative search volume (RSV). RSV is a normalized value on a scale from zero to one hundred, where the value of one hundred represents the highest search volume over a selected time frame. In contrast, a value of zero means the least absolute search volume. RSV evaluated the Google search frequency for commonly used gastrointestinal diseases, symptoms, and procedure terms (Tables 1, 2, 3, 4, 5, 6, 7, 8 and 9).

Data analysis procedure

RSV for gastrointestinal search terms was identified using region, category, and date filters. The inclusion strategy for the RSV that was used for this study was inputting the search terms “USA” and “March 1, 2018, to August 31, 2021” and “All Categories” into Google Trends. There were no exclusion criteria. The gastrointestinal search terms (for example, Diverticulosis, Nausea, colonoscopy) were divided into the categories they represented: disease, symptom, and procedure.

In addition, the correlation between monthly RSV values was compared to the number of new monthly COVID-19 cases assessed. New COVID-19 case numbers were extracted from the Johns Hopkins COVID-19 database (Coronavirus Resource Center 2021).

Statistical analyses

Monthly American RSV data during the “pandemic period” (March 2020 to August 2021) were compared to mean monthly RSV data from the “pre-pandemic period” (March 2018-February 2020). The t-test of the two independent samples assuming unequal variances was utilized in Microsoft Excel 2019 to compare the two groups in public interest during the seasons of the COVID-19 pandemic in America. A p-value < 0.05 was established to be statistically significant in this study. All statistical analyses were conducted on Microsoft Excel 2019. The presentation of statistical results was similar to a recent review (Misra et al. 2021; Gupta et al. 2021), where Google Trends terms are compared over time (Tables 1, 2, 3, 4, 5, 6, 7, 8 and 9). In addition, Spearman’s Rho correlation test compared monthly RSV with new monthly COVID-19 cases.

Results

When analyzing the data, search terms were separated into disease, procedure, and symptom categories. Data from the COVID-19 pandemic was collected from March 2020 to August 2021. This period was divided into six seasons: spring 2020 (March–May), summer 2020 (June–August), fall 2020 (September to November), winter 2020 (December to February), spring 2021 (March–May), and summer 2021 (June–August). These RSV values were compared with those from overlapping months between 2018 and 2020. Data and graphics of the internet search trends in gastrointestinal terms are shown in Tables 1, 2, 3, 4, 5, 6, 7, 8 and 9 and Fig. 1.

Disease terms (Tables 1, 2, and 7 and Fig. 1)

During spring 2020, the disease search terms of Carcinoid Tumor, Polyps, Diverticulosis, Colon Cancer, Rectal Cancer, C Diff, Celiac, Disease, Diverticulitis, Colitis, Irritable Bowel Syndrome (10 out of 15 search terms) had a statistically significant (p < 0.05) decrease in RSV when compared to the pre-pandemic period (in order of descending percent change). In summer 2020, there were
| Disease terms           | Spring 2020 (March to May) vs. 2018/2019 | Summer 2020 (June to August) vs. 2018/2019 | Fall 2020 (September to November) vs. 2018/2019 |
|------------------------|-----------------------------------------|-------------------------------------------|-----------------------------------------------|
|                        | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | P-value |
| Anal Cancer            | 17 (3.5)           | 32.8 (12.1)              | -48.2               | 39.7 (29.8)          | -45.4               | 0.345 (23.7)       | 33.8 (13.8)          | -30               | 0.261 |
| C Diff                 | 66 (16.8)          | 89.8 (5.7)               | -26.5               | 91.8 (4.4)           | -31.8               | <0.001 (59.7)       | 87 (4.3)            | -31.4             | <0.001 |
| Carcinoid Tumor        | 51 (4.6)           | 87 (9.3)                 | -41.4               | <0.001 (61.3)        | -19.7               | 0.099 (56.7)        | 83.7 (14.8)         | -32.3             | 0.024 |
| Celiac Disease         | 67 (7)             | 90.3 (3.6)               | -25.8               | <0.001 (68.7)        | -22.4               | <0.001 (71.3)       | 88.2 (3.3)          | -19.1             | <0.001 |
| Colitis                | 73.3 (6.7)         | 88.8 (4.7)               | -17.4               | 92.2 (3.7)           | -4.9                | 0.139 (86.7)        | 87.2 (4.8)          | -6.0              | 0.888 |
| Colon Cancer           | 24.7 (1.2)         | 35.2 (2.9)               | -29.9               | 32.7 (1.2)           | 59.2                | 0.259 (40.7)        | 32.2 (1.6)          | 26.4              | 0.058 |
| Crohn's Disease        | 62.7 (14)          | 73 (8.6)                 | -14.2               | 75.5 (12.2)          | -20.1               | 0.095 (51)          | 64.7 (7.3)          | -21.1             | 0.019 |
| Diverticulitis         | 69.7 (4.2)         | 91.3 (3.9)               | -23.7               | <0.001 (82.7)        | -10.8               | 0.006 (84)          | 85.8 (5)            | -2.1              | 0.587 |
| Diverticulosis         | 58.7 (7.4)         | 89.2 (5.6)               | -34.2               | <0.001 (74.5)        | -18.2               | 0.001 (71)          | 84.8 (1.7)          | -16.3             | <0.001 |
| Hemorrhoids            | 75.3 (9.8)         | 88.3 (9.5)               | -14.7               | 82.3 (7.9)           | 2                   | 0.761 (87.7)        | 77.5 (10.3)         | 13.1              | 0.144 |
| Inflammatory Bowel Disease | 63 (9.2)       | 75.8 (10.1)              | -16.9               | 69 (10.1)            | 0.5                 | 0.96 (71)           | 79 (11.7)           | -10.1             | 0.338 |
| Irritable Bowel Syndrome | 78 (8.5)         | 89.5 (4.7)               | -12.8               | 87 (3)               | -3.4                | 0.184 (82.3)        | 86.3 (5.4)          | -4.6              | 0.347 |
| Polyps                 | 60 (12.5)          | 95.3 (3.9)               | -37.1               | <0.001 (78.3)        | -12.8               | 0.009 (89.3)        | 88.7 (7.1)          | 0.8               | 0.893 |
| Rectal Cancer          | 62 (2.6)           | 84.5 (6.9)               | -26.6               | 85.2 (7.7)           | -6.8                | 0.566 (87.1)        | 84.7 (8.6)          | 2.8               | 0.666 |
| Ulcerative Colitis     | 61.7 (4.2)         | 69 (5)                   | -10.6               | 67.7 (4.8)           | 4.9                 | 0.35 (67)           | 66 (4)              | 1.5               | 0.699 |
| Disease terms          | Winter 2020 (December 2020 to February 2021) vs. 2018/2019 | Spring 2021 (March to May) vs. 2018/2019 | Summer 2021 (June to August) vs. 2018/2019 |
|-----------------------|------------------------------------------------------------|-----------------------------------------|-------------------------------------------|
|                       | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | P-value | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | P-value | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | P-value |
| Anal Cancer           | 24.7 (0.6)         | 24 (2.9)               | 2.8                  | 0.714   | 24.2 (2.6)         | 24 (2.9)               | 0.714   | 22.7 (2.1)         | 22 (2.1)         | 0.714   | 22.7 (2.1)         | 22 (2.1)         | 0.714   |
| C Diff                | 58 (1)             | 90.7 (5.6)             | −36                  | <0.001  | 89.8 (5.7)         | 23.6 0                 | 0.001  | 78 (7)             | 78 (7)           | 0.001  | 78 (7)             | 78 (7)           | 0.001  |
| Carcinoid Tumor       | 70.3 (5.5)         | 68.5 (11.9)            | 2.7                  | 0.182   | 87 (9.3)           | −36.4 0                | 0.001  | 57 (16.8)          | 57 (16.8)        | 0.001  | 57 (16.8)          | 57 (16.8)        | 0.001  |
| Celiac Disease        | 76 (4.6)           | 90.7 (6.4)             | −16.2                | 0.01    | 84.3 (8.1)         | 90.3 (3.6)             | 0.153  | 80.7 (2.1)         | 80.7 (2.1)       | 0.153  | 80.7 (2.1)         | 80.7 (2.1)       | 0.153  |
| Colitis               | 83.7 (3.1)         | 91.2 (4.3)             | −8.2                 | 0.033   | 85.7 (0.6)         | −3.6 0                 | 0.295  | 89.3 (0.6)         | 89.3 (0.6)       | 0.295  | 89.3 (0.6)         | 89.3 (0.6)       | 0.295  |
| Colon Cancer          | 35.7 (3.1)         | 31.8 (2.8)             | 12                   | 0.1     | 37 (1.7)           | 35.2 (2.9)             | 5.2    | 84.8 (15.5)        | 84.8 (15.5)      | 5.2    | 84.8 (15.5)        | 84.8 (15.5)      | 5.2    |
| Crohn’s Disease       | 57.3 (6.1)         | 63.5 (5.3)             | −9.7                 | 0.159   | 62 (2.2)           | −15.1 0                | 0.073  | 52 (8.2)           | 52 (8.2)         | 0.073  | 52 (8.2)           | 52 (8.2)         | 0.073  |
| Diverticulitis        | 83.4 (4.6)         | 85.7 (4.3)             | −3.1                 | 0.416   | 89 (2.6)           | 91.3 (3.9)             | −2.6   | 92 (7)             | 92 (7)           | 0.001  | 92 (7)             | 92 (7)           | 0.001  |
| Diverticulosis        | 81 (9.8)           | 89 (7.2)               | −9                   | 0.201   | 80.7 (3.1)         | 89.2 (5.6)             | −9.5   | 89.7 (7.1)         | 89.7 (7.1)       | 0.047  | 89.7 (7.1)         | 89.7 (7.1)       | 0.047  |
| Hemorrhoids           | 95 (5)             | 77.8 (10.2)            | 22.1                 | 0.031   | 93 (2)             | 88.3 (9.5)             | 5.3    | 93.3 (2.1)         | 93.3 (2.1)       | 0.442  | 93.3 (2.1)         | 93.3 (2.1)       | 0.442  |
| Inflammatory Bowel Disease | 66.7 (11)      | 78.7 (3.6)             | −15.3                | 0.038   | 68.3 (5.9)         | −9.9 0                 | 0.28   | 64.3 (14.4)        | 64.3 (14.4)      | 0.28   | 64.3 (14.4)        | 64.3 (14.4)      | 0.28   |
| Irritable Bowel Syndrome | 80.7 (2.5)     | 84 (6.4)               | −4.9                 | 0.302   | 82.7 (4.9)         | 89.5 (4.7)             | −7.6   | 77.3 (9.3)         | 77.3 (9.3)       | 0.083  | 77.3 (9.3)         | 77.3 (9.3)       | 0.083  |
| Polyps                | 86 (7.8)           | 90.8 (5.2)             | −5.3                 | 0.295   | 92 (4.6)           | 95.3 (3.9)             | −3.5   | 92.3 (0.6)         | 92.3 (0.6)       | 0.287  | 92.3 (0.6)         | 92.3 (0.6)       | 0.287  |
| Rectal Cancer         | 79.3 (4.5)         | 81.3 (7.3)             | −2.5                 | 0.684   | 82.3 (6.7)         | 84.5 (6.9)             | −2.6   | 77.3 (6.1)         | 77.3 (6.1)       | 0.666  | 77.3 (6.1)         | 77.3 (6.1)       | 0.666  |
| Ulcerative Colitis    | 65 (3)             | 70.8 (6.2)             | −8.2                 | 0.176   | 69 (2.6)           | 69 (5)                 | 0      | 66 (1)             | 66 (1)           | 0      | 66 (1)             | 66 (1)           | 0      |
Table 3  Gastrointestinal Google search volumes during the COVID-19 pandemic seasons. March 2020 to November 2020 (symptom terms)

| Symptom terms | Spring 2020 (March to May) vs. 2018/2019 | Summer 2020 (June to August) vs. 2018/2019 | Fall 2020 (September to November) vs. 2018/2019 |
|---------------|-----------------------------------------|------------------------------------------|-----------------------------------------------|
|               | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | P-value | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | P-value | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | P-value |
| Abdominal Pain | 82.3 (2.5)         | 91.3 (5.9)        | −9.9           | 0.042   | 86 (6.6)           | 92.7 (3.5)      | −7.2          | 0.079   | 87.7 (3.8)       | 79 (2.1)        | 8.4          | 0.006   |
| Constipation   | 80.7 (4)           | 82 (4)            | −1.6           | 0.655   | 85.7 (1.5)         | 82.7 (1.9)      | 3.6           | 0.048   | 85.7 (3.1)       | 79 (2.1)        | 8.4          | 0.006   |
| Diarrhea       | 80.7 (14.4)        | 77 (3.2)          | 4.8            | 0.544   | 84.3 (5.9)         | 81.3 (2.9)      | 3.7           | 0.32    | 73.7 (2.5)       | 71 (2.9)        | 3.8          | 0.219   |
| Hematochezia   | 69.3 (10.1)        | 79.7 (10.9)       | −13            | 0.213   | 67.3 (8)          | 79.8 (4.8)      | −15.7         | 0.02    | 74.7 (13.7)      | 72 (8.4)        | 3.7          | 0.722   |
| Melena         | 66 (3)             | 80.7 (6.5)        | −18.2          | 0.008   | 65.3 (8.1)        | 73.5 (6.4)      | −11.1         | 0.141   | 77.7 (6.5)       | 74 (4.1)        | 5            | 0.329   |
| Nausea         | 85.7 (5.5)         | 83.3 (2.7)        | 2.8            | 0.402   | 92.3 (4)          | 85.5 (2.1)      | 8             | 0.01    | 84 (1.7)         | 81 (1.7)        | 3.7          | 0.04    |
| Vomiting       | 77.7 (11.9)        | 82.5 (5.8)        | −5.9           | 0.422   | 71.7 (5.7)        | 73.2 (3.9)      | −2.1          | 0.651   | 68 (4)           | 73.7 (4.9)      | −7.7         | 0.128   |

Table 4  Gastrointestinal Google search volumes during the COVID-19 pandemic seasons. December 2020 to August 2021 (symptom terms)

| Symptom terms | Winter 2020 (December 2020 to February 2021) vs. 2018/2019 | Spring 2021 (March to May) vs. 2018/2019 | Summer 2021 (June to August) vs. 2018/2019 |
|---------------|------------------------------------------------------------|----------------------------------------|--------------------------------------------|
|               | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | P-value | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | P-value | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | P-value |
| Abdominal Pain | 91.3 (2.3)         | 88 (4)            | 3.8            | 0.232   | 89.3 (2.3)        | 91.3 (5.9)      | −2.2          | 0.596   | 91 (1)           | 92.7 (3.5)       | −1.8          | 1        |
| Constipation   | 95.3 (4.2)         | 85.5 (4.8)        | 11.5           | 0.02    | 92 (2.6)          | 82 (4)         | 12.2          | 0.007   | 91.3 (3.5)       | 82.7 (1.9)       | 10.5         | 1        |
| Diarrhea       | 75.7 (1.5)         | 77.2 (2.8)        | −1.9           | 0.423   | 81.3 (3.8)        | 77.3 (3.2)      | 5.6           | 0.11    | 96.3 (5.5)       | 81.3 (2.9)       | 18.4         | 1        |
| Hematochezia   | 72.3 (12.7)        | 67.2 (6.4)        | 7.7            | 0.429   | 86.3 (15.2)       | 79.7 (10.9)     | 8.4           | 0.468   | 74 (10.4)        | 79.8 (4.8)       | −7.3         | 0.634    |
| Melena         | 63.3 (4)           | 72.8 (3.1)        | −13            | 0.006   | 78.7 (9.9)        | 80.7 (6.5)      | −2.5          | 0.721   | 77.3 (7.1)       | 73.5 (6.4)       | 5.2          | 0.723    |
| Nausea         | 91 (1.7)           | 88.8 (3)          | 2.4            | 0.293   | 89.3 (3.5)        | 83.3 (2.7)      | 7.2           | 0.023   | 92 (8.5)         | 85.5 (2.1)       | 7.6          | 0.732    |
| Vomiting       | 73 (2)             | 90.7 (5.2)        | −19.5          | 0.001   | 80.7 (3.1)        | 82.5 (5.8)      | −2.2          | 0.629   | 81 (5.2)         | 73.2 (3.9)       | 10.7         | 0.711    |
Table 5 Gastrointestinal Google search volumes during the COVID-19 pandemic seasons. March 2020 to November 2020 (procedure terms)

| Procedure terms | Winter 2020 (March to May) vs. 2018/2019 | Spring 2020 (June to August) vs. 2018/2019 | Fall 2020 (September to November) vs. 2018/2019 |
|-----------------|----------------------------------------|----------------------------------------|----------------------------------------|
|                 | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) |
| Anoscopy        | 47.7 (19.9)         | 65.3 (22.3)            | −27                | 0.286               | 47 (8.2)              | 67.3 (18.7)          | −30.2               | 0.123               | 62.3 (3.8)           |
| Capsule Endoscopy| 44 (17.3)           | 74.5 (15.2)            | −40.9              | 0.029               | 74 (25.1)             | 68.7 (13.3)          | 7.8                 | 0.679               | 71.7 (12)            |
| Colectomy       | 57.3 (10.3)         | 67.8 (9.1)             | −15.5              | 0.159               | 70.7 (5.7)            | 74.8 (5.6)           | −5.6                | 0.328               | 66 (7.9)             |
| Colonoscopy     | 39 (16)             | 74.8 (4.7)             | −47.9              | 0.001               | 69.7 (6.4)            | 77.2 (3)             | −9.7                | 0.042               | 81 (4.6)             |
| Endoscopy       | 55.7 (14.6)         | 85 (3.1)               | −34.5              | 0.001               | 83.3 (1.2)            | 85.3 (4.2)           | −2.3                | 0.456               | 83.7 (5.9)           |
| Enteroscopy     | 47.7 (17)           | 57.8 (24.3)            | −17.6              | 0.542               | 44.3 (16.7)           | 59.7 (8.1)           | −25.7               | 0.096               | 61 (11.8)            |
| Sigmoidoscopy   | 41.7 (11.2)         | 80.2 (12.1)            | −48                | 0.003               | 48.7 (8.7)            | 73.7 (15.1)          | −33.9               | 0.036               | 82 (12.5)            |

Table 6 Gastrointestinal Google search volumes during the COVID-19 pandemic seasons. December 2020 to August 2021 (procedure terms)

| Procedure terms | Winter 2020 (December 2020 to February 2021) vs. 2018/2019 | Spring 2021 (March to May) vs. 2018/2019 | Summer 2021 (June to August) vs. 2018/2019 |
|-----------------|----------------------------------------------------------|----------------------------------------|----------------------------------------|
|                 | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) |
| Anoscopy        | 57 (9.2)          | 63 (24.5)             | −9.5                | 0.702               | 65 (13.7)             | 65.3 (22.3)          | −0.5                | 0.982               | 62 (21.6)            |
| Capsule Endoscopy| 63.3 (1.5)         | 75.2 (17)             | −15.7              | 0.282               | 77 (21.8)             | 74.5 (15.2)          | 3.4                 | 0.844               | 61.3 (16.6)           |
| Colectomy       | 69.7 (10.8)       | 78.8 (14.4)           | −11.6              | 0.367               | 82 (15.6)             | 67.8 (9.1)           | 20.9                | 0.12                | 71 (11.5)            |
| Colonoscopy     | 74 (5.3)          | 76.2 (6.6)            | −2.8               | 0.637               | 88.7 (1.2)            | 74.8 (4.7)           | 18.5                | 0.002               | 94.7 (4.7)           |
| Endoscopy       | 82 (8)            | 83.5 (4.8)            | −1.8               | 0.731               | 94.3 (5.1)            | 85.3 (1.1)           | 11                  | 0.01                | 90.3 (3.5)           |
| Enteroscopy     | 34.7 (15.9)       | 59.3 (15.1)           | −41.6              | 0.057               | 68.7 (2.3)            | 57.8 (24.3)          | 18.7                | 0.48                | 69.7 (9.3)           |
| Sigmoidoscopy   | 62 (16.5)         | 67.5 (5.5)            | −8.1               | 0.461               | 77.3 (11.8)           | 80.2 (12.1)          | −3.5                | 0.749               | 63.7 (19.5)           |
also decreases in RSV, although this season only had 5 out of 15 with statistical significance, suggesting a modest rebound in the public interest. This trend continues as the number of significant differences went from five terms (fall 2020) to 4 terms (winter 2020) to 3 terms (spring 2021) to 0 terms (summer 2021). This pattern correlates with the increased vaccine rollout period starting in winter 2020.

When comparing monthly disease RSV with new COVID-19 cases, there was no correlation among disease term RSV ($rs = -0.3065, p$ (2-tailed) $= 0.21606$).

When comparing the first year of the pandemic (March 2020 to February 2021) to the pre-pandemic period, 12 out of 15 disease search terms decreased in RSV. In the entirety of the study period (March 2020 to August 2021), 13 out of 15 disease search terms had a decrease in RSV.

### Symptoms terms (Tables 3, 4, and 8 and Fig. 1)

COVID-19’s impact on symptom search terms was inconsistent between and within seasons. For example, “Nausea” had fluctuating significance. In spring 2020, the $p$-value was 0.4. The $p$-values of summer 2020 and fall 2020 were 0.01 and 0.04, respectively. Then in winter 2020, “Nausea” became insignificant again at a $p$-value of 0.293. By comparing only, the summer 2020 terms, “Nausea” and “Constipation” had

| Disease terms   | Pandemic (March 2020 to February 2021) vs. pre-pandemic | Pandemic (August 2020 to February 2021) vs. pre-pandemic |
|-----------------|--------------------------------------------------------|--------------------------------------------------------|
|                 | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | $P$-value | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | $P$-value |
| Anal Cancer     | 21.8 (3.6)          | 32.6 (17.3)             | −33.2             | 0.041     | 22.3 (3.3)          | 32.6 (17.3)             | −31.6             | 0.017     |
| C Diff          | 61.6 (8.3)          | 89.8 (5.1)              | −31.4             | <0.001    | 65.5 (9.5)          | 89.8 (5.1)             | −27.1             | <0.001    |
| Carcinoid Tumor | 59.8 (10.1)         | 78.9 (13.3)             | −24.1             | <0.001    | 58.6 (10.2)         | 78.9 (13.3)             | −25.7             | <0.001    |
| Celiac Disease  | 70.8 (5.4)          | 89.4 (4.2)              | −20.9             | <0.001    | 74.7 (7.8)          | 89.4 (4.2)             | −16.5             | <0.001    |
| Colitis         | 82.8 (7.2)          | 89.8 (4.5)              | −7.8              | 0.001     | 84.4 (6.4)          | 89.8 (4.5)             | −6.1              | 0.002     |
| Colon Cancer    | 38.3 (21)           | 33 (2.5)                | 16.1              |          | 33 (2.5)            | 33 (2.5)                | 13.4              | 0.212     |
| Crohn’s Disease | 57.8 (8.7)          | 69.2 (9.7)              | −16.4             | 0.002     | 75.7 (8.1)          | 69.2 (9.7)             | −16.8             | <0.001    |
| Diverticulitis  | 79.8 (6.9)          | 88.9 (5.2)              | −10.2             | <0.001    | 83.4 (8.1)          | 88.9 (5.2)             | −6.2              | 0.011     |
| Diverticulosis  | 71.2 (10.2)         | 88.4 (5.1)              | −19.5             | <0.001    | 75.8 (11.3)         | 88.4 (5.1)             | −14.2             | <0.001    |
| Hemorrhoids     | 85.5 (9.1)          | 81.5 (10)               | 4.9               | 0.251     | 88.1 (8.3)          | 81.5 (10)              | 8                 | 0.029     |
| Inflammatory Bowel Disease | 67.5 (8.2) | 75.6 (9.7) | −10.7 | 0.018 | 67.1 (8.6) | 75.6 (9.7) | −11.3 | 0.005 |

| Symptom terms   | Pandemic (March 2020 to February 2021) vs. pre-pandemic | Pandemic (August 2020 to February 2021) vs. pre-pandemic |
|-----------------|--------------------------------------------------------|--------------------------------------------------------|
|                 | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | $P$-value | Pandemic mean (SD) | Pre-pandemic mean (SD) | Percent change (%) | $P$-value |
| Abdominal Pain  | 86.8 (4.9)          | 89.8 (4.6)              | −3.3              | 0.085     | 87.9 (4.4)          | 89.8 (4.6)             | −2.1              | 0.198     |
| Constipation    | 86.8 (6.2)          | 82.3 (4)                | 5.5               | 0.012     | 88.4 (5.8)          | 82.3 (4)               | 7.5               | <0.001    |
| Diarrhea        | 78.6 (8)            | 76.6 (4.7)              | 2.6               | 0.359     | 82 (9.6)            | 76.6 (4.7)             | 7                 | 0.021     |
| Hematochezia    | 70.9 (10.1)         | 74.7 (9.2)              | −5                | 0.273     | 74 (11.8)           | 74.7 (9.2)             | −0.9              | 0.838     |
| Melena          | 68.1 (7.7)          | 75.3 (5.9)              | −9.5              | 0.004     | 71.4 (8.9)          | 75.3 (5.9)             | −5.1              | 0.097     |
| Nausea          | 88.3 (4.8)          | 84.7 (3.7)              | 4.2               | 0.018     | 89.1 (5.2)          | 84.7 (3.7)             | 5.2               | 0.003     |
| Vomiting        | 72.6 (7)            | 80 (8.7)                | −9.3              | 0.015     | 75.3 (7.2)          | 80 (8.7)               | −5.8              | 0.072     |
statistically significant increases with \( p \)-values of 0.01 and 0.048 respectively, but “Hematochezia” had a statistically significant decrease with a \( p \)-value of 0.02. One possible explanation for this inconsistency is that some gastrointestinal symptoms overlap with COVID-19 symptoms. When comparing symptom RSV with COVID-19 cases, there was
no correlation among symptom term RSV ($rs = 0.12597$, $p$ (2-tailed) $= 0.61844$).

**Procedure terms (Tables 5, 6, and 9 and Fig. 1)**

In spring 2020, the procedure search terms of sigmoidoscopy, colonoscopy, capsule endoscopy, and endoscopy (four out of seven search terms) had a statistically significant ($p < 0.05$) decrease in RSV when compared to the pre-pandemic data (in order of descending percent change). During summer 2020, sigmoidoscopy and colonoscopy still had a relative decrease in RSV, which indicates a continued decrease in the public interest for these terms. For fall 2020 and spring 2021, COVID-19 cases were at their lowest, and during this time, only two terms (colonoscopy and endoscopy) had statistically increased ($p$-values of 0.01 and 0.002), but nearly all terms showed an increase to levels above pre-pandemic levels. This suggests a surge in procedure interest due to a backlog of procedures.

Furthermore, there was a decrease in six out of seven terms in the first year of the pandemic (March 2020 to February 2021). When looking at the total study period (March 2020 to August 2021), only one procedure (sigmoidoscopy) had decreased RSV. When comparing procedure RSV with new COVID-19 cases, there was a strong negative correlation among procedure term RSV ($rs = -0.67596$, $p$ (2-tailed) = 0.00207).

**Discussion**

The declaration of the COVID-19 as a global pandemic by the WHO on March 11, 2020 has dramatically affected the public interest and access to medical services (timeline of WHO’s response to COVID-19 2020). The general population’s attention rapidly shifted as national lockdown orders were imposed, COVID-19 vaccines were distributed, and seasonal variations in case numbers endured. For example, a Google Scholar search for “Gastroenterology” showed a temporal difference in gastroenterological studies published throughout the pandemic. The Google Scholar articles changed from 153,000 in 2019 to 120,000 in 2020 to 87,800 in 2021 (Google scholar 2022). The decrease in gastroenterology topics includes research as well as the general population.

Compared to previous years’ data, this manuscript’s study observed a reduction in the relative search volume of 10 out of 15 gastrointestinal disease search terms during the early pandemic. Following this downtrend was a relative rebound to baseline during fall 2020 with reductions in 5 out of 15 search terms and only three by spring 2021. The issuance of “stay at home” orders in the USA may explain the reductions in RSV when the public focus shifted away from gastroenterological health maintenance to the severe respiratory infection caused by COVID-19 infection (Coronavirus Guidelines for America 2020; KFF 2020). However, the lock down measures proved necessary to reduce the transmission of COVID-19 by avoiding unnecessary patient traffic in hospitals and from hospitals to the community (Brindle and Gawande 2020; COVID-surg Collaborative 2020). Recent literature has cited similar trends in respiratory syncytial virus (RSV) across various medical specialties when comparing the initial phase of the pandemic to later seasons. For example, Esen-Salman et al. (2021) conducted a Google Trends analysis of public interest in dermatologic symptoms, conditions, treatments, and procedure search terms throughout the COVID-19 pandemic. Comparable to this study’s findings, there was initially a marked decrease in the public interest, followed by a shift in RSV to levels before the pandemic.

Of the seven search terms related to gastrointestinal symptoms, the phrases “nausea,” “diarrhea,” and “constipation” displayed significant increases in search volume throughout the total study period. Specific gastrointestinal symptoms such as nausea and diarrhea appear before presentation with COVID-19 infection, which may explain this statistical finding (Cholankeril et al. 2020). Cholankeril et al. (2020) research points out that the SARS-CoV-2 virus utilizes the cellular receptor angiotensin-converting enzyme 2 (ACE2) as part of the virus’s replication cycle. ACE2 receptor is widely expressed within the gastrointestinal tract. Because of this association, elucidation of COVID-19 symptomatology through Google Trends may be a valuable indication to screen for possible infection.

In spring 2020, procedural search terms in four of seven key terms representing sigmoidoscopy, colonoscopy, capsule endoscopy, and endoscopy decreased in internet search traffic compared to previous years. Countries’ responses to the pandemic must consider environmental, economic, and social aspects. Countries that struggle with COVID-19 containment have uncertain, delayed, or ambiguous responses to the pandemic (Coccia 2021). America’s Centers for Medicare and Medicaid Services imposed a temporary measure to “[delay] all elective surgeries, non-essential medical, surgical, and dental procedures” in response to the growing pandemic (Trump 2020; Centers for Medicare and Medicaid Services 2020; Goldman and Haber 2020). The postponement was an essential step to reduce the transmission of COVID-19 and ensure both patient and medical personnel safety (KFF 2020; Brindle and Gawande 2020). Despite this reduction in procedures, many hospitals and medical practices began operating under maximal capacity (Dhanda et al. 2020). Sawhney et al. (2020) observed the deferral of many gastrointestinal procedures in the early stages of the COVID-19 pandemic to a later period upon formalizing guidelines with more significant safety measures. Many healthcare institutions adapted to the pandemic by implementing new
During spring 2021, there was a statistically significant rebound in the RSV terms for colonoscopy and endoscopies. In addition, nearly all the terms had a non-statistically significant increase above pre-pandemic levels. These observations correlated when the COVID-19 vaccine became available, lockdown measures were lifted, and COVID-19 cases were at their lowest (Tables 3 and 6 and Fig. 1). These events led to progressive increases in elective procedures to meet the growing demand for those treated earlier in the pandemic (Moletta et al. 2020).

Due to the backlog of procedures, multiple medical specialties observed increased workload upon lifting lockdown restrictions and returning to pre-pandemic life. Bambhivani et al. (2020) observed a rebound of procedural capacity in May 2021 among all urological procedure categories except male infertility. Similar reports indicate a growing interest in non-essential cosmetic facial plastic surgery in the face of the ongoing pandemic (Dhanda et al. 2020). A single-center prospective cohort study conducted by Dawod et al. (2021) indicated that endoscopy procedures with appropriate personal protective equipment and preoperative testing are associated with a low risk of periprocedural COVID-19 infection for outpatients and endoscopy unit staff. Proper implementation of infection prevention measures, and increased vaccination efforts, may pave the way for the regular utility of healthcare services.

The COVID-19 pandemic established severe barriers to access adequate care for many patients nationwide. In addition, the growing public fear of entering hospitals and healthcare facilities may have led to delayed diagnosis, progression of specific medical conditions, and decreased overall quality of life (ACS 2020). For example, Khan et al. (2021) reported that COVID-19 patients with a pre-existing diagnosis of gastrointestinal cancers had a significantly higher risk of hospitalization (RR 2.37, 95% CI 2.19–2.55), mechanical ventilation (RR 2.16, 95% CI 1.69–2.75), and mortality (RR 3.81, 95% CI 3.14–4.63) compared to the control group. Therefore, clinicians should take extra caution when delaying treatment and prioritize those with high-risk conditions to prevent worse outcomes in COVID-19 patients with pre-existing gastrointestinal cancer and delayed access to care.

Williams et al. (2020) wrote a paper detailing how scientific evidence can shape policy. When looking at different countries’ responses to the COVID-19 pandemic, the most influential governmental policy responses utilized scientific evidence to benefit their society and environment. In addition to William’s research, this manuscript provides valuable information for policymakers when evaluating gastrointestinal needs in a new pandemic environment. Governmental agencies can see that when COVID-19 cases spike and public interest in gastrointestinal topics decreases, they must be prepared for the backlog of procedures and potential worsening of gastrointestinal disease.

The COVID-19 pandemic decreased the outreach physicians have in education and guidance for their patients, which may have resulted in reduced RSV compared to previous years. In otolaryngology, there was roughly an 80% reduction in the number of completed appointments from mid-March 2020 to mid-April 2020 compared with the corresponding period in 2019 (Kasle et al. 2020). Emergency department consultations for otolaryngology-related concerns were also reduced by nearly 80% throughout the pandemic (Shipchandler et al. 2020). To combat the lack of access to medical services, healthcare providers have responded by providing care through telemedicine (Rodriguez et al. 2021). Outpatient visits in gastroenterology clinics via telemedicine may reduce exposure to COVID-19 and remove barriers to care for many patients (Keesara et al. 2020).

The COVID-19 pandemic has severely impacted the lifestyle and health of the US population at large. Opportunities for physical activity were limited during the lockdown upon the closure of many gyms, workplaces, and public spaces. During the COVID-19 pandemic, the overall step counts rapidly decreased worldwide (Keesara et al. 2020). As a result, sedentary lifestyles and unhealthy dietary habits became routine for many. An inability to work or exercise, replaced by increased sugar and alcohol intake, may escalate stress and anxiety levels and worsen existing mental health issues (World Health Organization 2020; Foulds et al. 2015; Tison et al. 2020; Mattioli et al. 2020). Nielsen reported a 54% increase in national sales of alcohol for the week ending on March 21, 2020, compared with 1 year before (The Nielsen Company 2020). Furthermore, increased alcohol use is linked to many gastrointestinal conditions such as esophageal squamous cell cancer, gastric cancer, hepatocellular carcinoma, and colorectal cancer (Scherübl 2020). Increased alcohol intake and exaggerated stress response may worsen several functional gastrointestinal disorders via pathways of the gut-brain axis (Gubatan et al. 2021). Physicians must consider lifestyle disturbances caused by the COVID-19 pandemic to optimize the delivery of high-quality healthcare with careful monitoring of alcohol-associated gastrointestinal disorders.

Google Trends contains many data that researchers can use to interpret population-level data. For example, through Google Trends, it can be observed that the COVID-19 pandemic significantly decreased the public interest in gastrointestinal topics in the initial phase of the pandemic. In contrast, in the later stage, public interest rebounded, particularly in terms of procedures. The main point of this study was to emphasize to healthcare professionals to be prepared for this surge in the public interest.
However, one limitation of Google Trends is that, although this study has shown a decrease in Google Trends search interest in gastrointestinal topics with subsequent elevations in later periods, there is no evidence to suggest that this could directly impact health outcomes. As with most studies, there is the potential to have confounding variables such as age, income, and location. Unfortunately, based on the Google Trends interface, one cannot stratify data to account for these confounding variables. If such a program was available, this could be the subject for future studies. In addition, this current research focuses on population-level data, and it might not be easy to generalize the statistical findings down to a single person. However, this data could benefit anyone, from a provider to a patient, by educating them about how gastrointestinal interest has changed throughout the pandemic. Another limitation is that internet searches were analyzed via English, whereas many internet searches may have been in a different language. Additionally, only one search engine was used. However, the Google search engine has approximately 90% of the internet market share (StatCounter Global Stats n.d.), likely presenting all internet searches. This study was further limited by the geographical variance in the institution of local lockdown measures and vaccination distribution efforts. Finally, Google Trends data is a compilation of the searches of individuals, and it is difficult to say whether these individual searches can be generalized to every member of American society.

Conclusion

Physicians should be aware of the societal changes in understanding gastrointestinal health over the pandemic. The initial decline of public interest has facilitated a new environment of a backlog of gastrointestinal screening tests that will delay patient care. As a result, future spikes of gastrointestinal cancer diagnosis could occur, and healthcare providers must be prepared for the challenge. This manuscript could foreshadow this surge. However, other studies are needed to show whether there will be a spike in gastrointestinal malignancies in the future. Google Trends has become a valuable tool to recognize changes in public search interest in medical knowledge and guide the management of patient care during future outbreaks in order to benefit a new environment shaped by the COVID-19 pandemic.

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Data availability Data are available from the corresponding authors upon a reasonable request.

Declarations

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