The Evolution of the COVID-19 Pandemic Through the Lens of Google Searches

Supplementary Information

Contents

S1 Search terms queried for analysis

In this section we show the number of countries where there was sufficient Google search data (Google only releases search information if there is sufficient data [1]) for each search term, among countries with available COVID-19 case data. Table S1 provides information for search terms related to possible COVID-19 symptoms, table S2 provides information for search terms used to understand the impact of containment policies, and table S3 provides information for search terms related to demand for information about vaccines.

Table S1: Symptoms Search Terms: Number of countries with available Google search interest data for each search term

Search Term	N Countries
Ageusia	81
Anosmia	102
Coronavirus	201
Cough	186
COVID Symptoms	138
COVID-19	200
Fever	195
How to Treat Coronavirus	42
I Can't Smell	33
I Can't Taste	16
Loss of Smell	109
Loss of Taste	105
Pneumonia	175
Shortness of Breath	130

Table S2: Impact of Containment Policy Search Terms: Number of countries with available Google search interest data for each search term

Search Term	N Countries
Anxiety	171
Anxiety Attack	74
Boredom	117
Debt	185
Divorce	181
Emergency Pill	42
File for Unemployment	23
Insomnia	157
Lonely	177
Panic	166
Pregnancy Test	156
Social Distance	84
Social Isolation	57
Stay at Home	119
Suicide	189
Unemployment	180
Unemployment Benefits	61
Unemployment Insurance	55
Unemployment Office	36
Wedding	203

Table S3: Vaccine Search Terms: Number of countries with available Google search interest data for each search term

Search Term	N Countries
Can I Get the COVID Vaccine	14
COVID Microchip	16
COVID Vaccine	123
COVID Vaccine Appointment	35
COVID Vaccine Approved	25
COVID Vaccine Blood Clots	15
COVID Vaccine Cause Infertility	6
COVID Vaccine Center	39
COVID Vaccine Change DNA	6
COVID Vaccine Dangerous	21
COVID Vaccine Infertility	11
COVID Vaccine Mercury	5
COVID Vaccine Microchip	8
COVID Vaccine Priority	14
COVID Vaccine Priority List	9
COVID Vaccine Reaction	19
COVID Vaccine Safety	24
COVID Vaccine Second Dose	45
COVID Vaccine Sick	19
COVID Vaccine Side Effects	82
Does COVID Vaccine Change DNA	5
Fear of Needles	29
Is COVID Vaccine Approved	12
Is the COVID Vaccine the Mark of the Beast	4
Ivermectin	163
Long Term Effects of COVID Vaccine	13
Needle Phobia	22
Safety of COVID Vaccine	13
Vaccine	198
Vaccine Allergy	30
Vaccine Appointment	50
Vaccine Near Me	33
Vaccine Reaction	36
Where to Get COVID Vaccine	19

S2 Determining Language with Most Google Search Activity in Each Country

We use the following steps to determine the language with the highest Google search activity for each country:

- **Step 1:** For each search term t, query search interest across translated versions of the search term within the same query. We query weekly search interest for all of 2020. The translated versions of search term t are included in the same query, which ensures search interest values across the translated terms are comparable.
- **Step 2:** The above step produces search interest at the weekly level for each translated version of search term t. We take the average value across the time series, yielding one value per translated version of search term t.
- **Step 3:** For each search term t, we standardize values of search interest for translated terms so that the maximum value is 100. This step is done because, from the above step, values are only comparable within translated versions of search term t.
- **Step 4:** Across languages, take the average value from the above step. The language with the highest value is used at the language with the highest search interest.

Table S4 shows an illustrative example using a country where English, French and Spanish are the main languages spoken, where we just consider translations for three words: "fever", "doctor" and "hospital"; in practice, we also use "food", "restaurant" and "football." The below example highlights the benefit of querying multiple search terms; the words for "doctor" and "hospital" are the same in English and Spanish, while the world for "fever" differs in English and Spanish. In addition, French sees the highest search activity for "fever" and "doctor" compared to English and Spanish versions; however, the French version of "hospital" sees slightly lower interest than the English and Spanish versions. Considering all search terms, though, indicates French will typically capture high search activity compared to searches in other languages. In step 3, standardizing allows comparing values between different search search terms; and averaging these values in step 4 shows that French has the highest average search activity; consequently, for this country, we query Google search interest in French.

Table S4: Illustrative example of determining most common language for Google searches

	Fever			Doctor			Hospital		
	English	French	Spanish	English	French	Spanish	English	French	Spanish
	Fever	fièvre	fiebre	doctor	médecin	doctor	hospital	hôpital	hospital
Step 1: Query weekly search interest for each translated search term									
Week 1	10	50	5	20	80	20	100	90	100
Week 2	50	100	10	10	75	10	60	70	60
Week 3	30	60	15	15	100	15	50	20	50
Step 2: Take average values across time series									
Avg	30	70	10	15	85	15	70	60	70
Step 3: Standardize values within translated search terms so maximum value is 100									
	42.85	100	14.28	17.64	100	17.64	100	85.71	100
Step 4: Average value across languages; French is used as it has the highest value below.									
• English: (42.85 + 17.64 + 100)/3 = 53.49									
• French: (100 + 100 + 85.71)/3 = 95.23									
• Spanish: (14.28 + 17.64 + 100)/ = 43.97									

Table S5 shows, for each country, the language with the highest Google search activity and the average search activity for each language considered. For each country, we compare search interest in languages identified here: `https://github.com/annexare/Countries/blob/master/dist/countries.csv`.

Table S5: Google search activity across countries and languages

Country	Language with	Language and Search Activity (S.A.)				
	Highest S.A.	Name (S.A.)	Name (S.A.)	Name (S.A.)	Name (S.A.)	Name (S.A.)
Andorra	Catalan	Catalan (100)				
United Arab Emirates	Arabic	Arabic (100)				
Afghanistan	Pashto	Pashto (75)	Turkmen (25)	Uzbek (25)		
Antigua & Barbuda	English	English (100)				
Anguilla	English	English (100)				
Albania	Albanian	Albanian (100)				
Armenia	Russian	Armenian (69.5)	Russian (76.2)			
Angola	Portuguese	Portuguese (100)				
Argentina	Spanish	Spanish (100)				
American Samoa	English	English (99.7)	Samoan (14.3)			
Austria	German	German (100)				
Australia	English	English (100)				
Aruba	Dutch	Dutch (100)	Punjabi (0)			
Azerbaijan	Azerbaijani	Azerbaijani (100)				
Bosnia & Herzegovina	Bosnian	Bosnian (93.4)	Croatian (81.7)	Serbian (0.1)		
Barbados	English	English (100)				
Bangladesh	Bengali	Bengali (100)				
Belgium	Dutch	German (16.6)	French (53.9)	Dutch (78.1)		
Burkina Faso	French	French (100)				
Bulgaria	Bulgarian	Bulgarian (100)				
Bahrain	Arabic	Arabic (100)				
Burundi	French	French (100)				
Benin	French	French (100)				
St. Barthélemy	French	French (100)				
Bermuda	English	English (100)				
Brunei	Malay	Malay (100)				
Bolivia	Spanish	Spanish (100)				
Brazil	Portuguese	Portuguese (100)				
Bahamas	English	English (100)				
Botswana	English	English (100)				
Belarus	Russian	Belarusian (15.4)	Russian (100)			
Belize	English	English (100)	Spanish (35.5)			
Canada	English	English (100)	French (30.5)			
Congo - Kinshasa	French	French (100)	Swahili (0.8)			
Central African Republic	French	French (100)				
Congo - Brazzaville	French	French (100)				
Switzerland	German	German (86.7)	French (51.7)	Italian (30.4)		
Côte d'Ivoire	French	French (100)				
Cook Islands	English	English (100)				
Chile	Spanish	Spanish (100)				
Cameroon	English	English (97.9)	French (64.5)			
China	Chinese	Chinese (100)				
Colombia	Spanish	Spanish (100)				
Costa Rica	Spanish	Spanish (100)				
Cuba	Spanish	Spanish (100)				
Cape Verde	Portuguese	Portuguese (100)				
Curaçao	English	English (88.9)	Dutch (67.4)	Punjabi (0)		
Cyprus	Turkish	Greek (36)	Armenian (0)	Turkish (94.5)		
Czechia	Czech	Czech (100)	Slovak (0.7)			
Germany	German	German (100)				
Djibouti	French	Arabic (2.5)	French (100)	Somali (0)		
Denmark	Danish	Danish (100)				
Dominica	English	English (100)				
Dominican Republic	Spanish	Spanish (100)				
Algeria	Arabic	Arabic (100)				
Ecuador	Spanish	Spanish (100)				
Estonia	Estonian	Estonian (100)				
Egypt	Arabic	Arabic (100)				
Eritrea	English	Arabic (0)	English (100)			
Spain	Spanish	Catalan (46.6)	Spanish (85.8)	Basque (0.3)	Galician (47.5)	
Ethiopia	Amharic	Amharic (100)				
Finland	Finnish	Finnish (100)	Swedish (13.5)			
Fiji	English	English (100)	Hindi (0)	Urdu (0)		
Falkland Islands	English	English (100)				
Micronesia	English	English (100)				
France	French	French (100)				
Gabon	French	French (100)				
United Kingdom	English	English (100)				
Grenada	English	English (100)				
Georgia	Georgian	Georgian (100)				
French Guiana	French	French (100)				

Guernsey	English	English (100)	French (28.6)			
Ghana	English	English (100)				
Gibraltar	English	English (100)				
Greenland	Danish	Danish (100)				
Gambia	English	English (100)				
Guinea	French	French (100)				
Guadeloupe	French	French (100)				
Equatorial Guinea	Spanish	Spanish (85.7)	French (25.9)			
Greece	Greek	Greek (100)				
Guatemala	Spanish	Spanish (100)				
Guam	English	English (100)	Spanish (28.6)			
Guinea-Bissau	Portuguese	Portuguese (100)				
Guyana	English	English (100)				
Hong Kong SAR China	English	English (83.9)	Chinese (49.3)			
Honduras	Spanish	Spanish (100)				
Croatia	Croatian	Croatian (100)				
Haiti	French	French (86.3)	Haitian Creole (34)			
Hungary	Hungarian	Hungarian (100)				
Indonesia	Indonesian	Indonesian (100)				
Ireland	English	English (100)	Irish (0.5)			
Israel	Hebrew	Arabic (44.9)	Hebrew (57.1)			
Isle of Man	English	English (100)				
India	English	English (100)	Hindi (5.7)			
Iraq	Arabic	Arabic (100)	Kurdish (0.9)			
Iran	Persian	Persian (100)				
Iceland	Icelandic	Icelandic (100)				
Italy	Italian	Italian (100)				
Jersey	English	English (100)	French (28.6)			
Jamaica	English	English (100)				
Jordan	Arabic	Arabic (100)				
Japan	Japanese	Japanese (100)				
Kenya	English	English (100)	Swahili (5.6)			
Kyrgyzstan	Russian	Kyrgyz (35.8)	Russian (100)			
Cambodia	Khmer	Khmer (100)				
Kiribati	English	English (100)				
Comoros	French	Arabic (0)	French (100)			
St. Kitts & Nevis	English	English (100)				
North Korea	Korean	Korean (100)				
South Korea	Korean	Korean (100)				
Kuwait	Arabic	Arabic (100)				
Cayman Islands	English	English (100)				
Kazakhstan	Russian	Kazakh (21.4)	Russian (100)			
Laos	Lao	Lao (100)				
Lebanon	Arabic	Arabic (85.3)	French (41.2)			
St. Lucia	English	English (100)				
Liechtenstein	German	German (100)				
Sri Lanka	Sinhala	Sinhala (83.3)	Tamil (42.7)			
Liberia	English	English (100)				
Lesotho	English	English (100)	Sesotho (1.7)			
Lithuania	Lithuanian	Lithuanian (100)				
Luxembourg	German	German (85.1)	French (66.8)	Luxembourgish (24.9)		
Latvia	Latvian	Latvian (100)				
Libya	Arabic	Arabic (100)				
Morocco	Arabic	Arabic (100)				
Monaco	French	French (100)				
Moldova	Romanian	Romanian (100)				
Montenegro	Bosnian	Bosnian (85.7)	Croatian (73.9)	Albanian (14.5)	Serbian (1)	
St. Martin (French)	English	English (100)	French (33.3)	Dutch (16.7)		
Madagascar	French	French (88.3)	Malagasy (51.3)			
Marshall Islands	English	English (100)				
North Macedonia	Macedonian	Macedonian (100)				
Mali	French	French (100)				
Myanmar (Burma)	Myanmar	Myanmar (100)				
Mongolia	Mongolian	Mongolian (100)				
Macao SAR China	Chinese	Portuguese (18.8)	Chinese (99.3)			
Northern Mariana Islands	English	English (100)				
Martinique	French	French (100)				
Mauritania	Arabic	Arabic (100)				
Montserrat	English	English (100)				
Malta	English	English (100)	Maltese (1.3)			
Mauritius	English	English (100)				
Maldives	English	Arabic (0.1)	English (100)			
Malawi	English	English (100)	Nyanja (0)			
Mexico	Spanish	Spanish (100)				
Malaysia	Malay	Malay (100)				
Mozambique	Portuguese	Portuguese (100)				
Namibia	English	Afrikaans (18.3)	English (100)			
New Caledonia	French	French (100)				
Niger	French	French (100)				
Nigeria	English	English (100)				
Nicaragua	Spanish	Spanish (100)				

Netherlands	Dutch	Dutch (100)				
Norway	Norwegian	Norwegian (100)				
Nepal	Nepali	Nepali (100)				
Nauru	English	English (100)				
Niue	English	English (100)				
New Zealand	English	English (100)	Maori (3.3)			
Oman	Arabic	Arabic (100)				
Panama	Spanish	Spanish (100)				
Peru	Spanish	Spanish (100)				
French Polynesia	French	French (100)				
Papua New Guinea	English	English (100)				
Philippines	English	English (100)				
Pakistan	English	English (100)	Urdu (1)			
Poland	Polish	Polish (100)				
St. Pierre & Miquelon	French	French (100)				
Pitcairn Islands	English	English (100)				
Puerto Rico	English	English (84.1)	Spanish (79.7)			
Palestinian Territories	Arabic	Arabic (100)				
Portugal	Portuguese	Portuguese (100)				
Palau	English	English (100)				
Paraguay	Spanish	Spanish (100)				
Qatar	Arabic	Arabic (100)				
Réunion	French	French (100)				
Romania	Romanian	Romanian (100)				
Serbia	Serbian	Serbian (100)				
Russia	Russian	Russian (100)				
Rwanda	English	English (100)	French (29.9)	Kinyarwanda (17.3)		
Saudi Arabia	Arabic	Arabic (100)				
Solomon Islands	English	English (100)				
Seychelles	English	English (100)	French (28.6)			
Sudan	Arabic	Arabic (76.1)	English (68.4)			
Sweden	Swedish	Swedish (100)				
Singapore	English	English (100)	Malay (15.8)	Tamil (0)	Chinese (7)	
St. Helena	English	English (100)				
Slovenia	Slovenian	Slovenian (100)				
Slovakia	Slovak	Slovak (100)				
Sierra Leone	English	English (100)				
San Marino	Italian	Italian (100)				
Senegal	French	French (100)				
Somalia	English	Arabic (4.8)	English (100)	Somali (1.3)		
Suriname	Dutch	Dutch (100)				
South Sudan	English	English (100)				
São Tomé & Príncipe	Portuguese	Portuguese (100)				
El Salvador	Spanish	Spanish (100)				
Sint Maarten	English	English (100)	Dutch (14.3)			
Syria	Arabic	Arabic (100)				
Eswatini	English	English (100)				
Turks & Caicos Islands	English	English (100)				
Chad	French	Arabic (0.8)	French (100)			
Togo	French	French (100)				
Thailand	Thai	Thai (100)				
Tajikistan	Russian	Russian (100)	Tajik (20.5)			
Tokelau	English	English (100)				
Timor-Leste	Portuguese	Portuguese (100)				
Turkmenistan	Russian	Russian (99.6)	Turkmen (29.9)			
Tunisia	Arabic	Arabic (100)				
Tonga	English	English (100)				
Turkey	Turkish	Turkish (100)				
Trinidad & Tobago	English	English (100)				
Tuvalu	English	English (100)				
Taiwan	Chinese	Chinese (100)				
Tanzania	English	English (100)	Swahili (22.3)			
Ukraine	Ukrainian	Ukrainian (100)				
Uganda	English	English (100)	Swahili (0.3)			
United States	English	English (100)				
Uruguay	Spanish	Spanish (100)				
Uzbekistan	Russian	Russian (87.9)	Uzbek (44.2)			
St. Vincent & Grenadines	English	English (100)				
Venezuela	Spanish	Spanish (100)				
British Virgin Islands	English	English (100)				
U.S. Virgin Islands	English	English (100)				
Vietnam	Vietnamese	Vietnamese (100)				
Vanuatu	English	English (100)	French (28.6)			
Wallis & Futuna	French	French (100)				
Samoa	English	English (100)	Samoan (0.5)			
Yemen	Arabic	Arabic (100)				
Mayotte	French	French (100)				
South Africa	English	Afrikaans (17.6)	English (100)	Sesotho (0.2)	Xhosa (0)	Zulu (0.1)
Zambia	English	English (100)				
Zimbabwe	English	English (100)	Shona (0.5)			

S3 Create consistent time-series of Google search interest

Google trends provides a scaled index of search interest that ranges between 0 and 100 across a specific time range and geographic region [1]. Google only allows querying data for a time range of up to 270 days; consequently, to create a consistent time series from September 1, 2018 to December 31, 2021, we query data for seven different time ranges. Given that Google scales values between 0 and 100 for each query, the values across different the different time series queries will not be comparable.

To create a consistent time series, we query data across time ranges that overlap. Specifically, we query data for:

- September 1, 2018 - May 28, 2019
- January 1, 2019 - September 27, 2019
- July 1, 2019 - March 26, 2020
- January 1, 2020 - September 26, 2020
- July 5, 2020 - March 31, 2021
- January 4, 2021 - September 30, 2021
- April 6, 2021 - December 31, 2021

We then use search interest in the overlapping time periods to scale the full range of data so that the range of values within overlapping time spans are the same. Specifically, we use the below equation[1]:

$$\frac{m - r_{min}}{r_{max} - r_{min}} \times (t_{max} - t_{min}) + t_{min} \tag{1}$$

where:

- r_{min} is the minimum value from the values to be scaled
- r_{max} is the maximum value from the values to be scaled
- t_{min} is the minimum of the target scaling
- t_{max} is the minimum of the target scaling
- $m \in [r_{min}, r_{max}]$ is the value to be scaled

and where r_{min}, r_{max}, t_{min}, t_{max} are determined from the set of values from the two time series where the dates overlap, and m is the full range of search interest values from the query. Figure S1 shows an example using search interest for "fever" in the United States; the figure shows both the raw values from the original search interest query (panel A) and the resulting consistent time series (panel B).

[1]This equation is described in this stack overflow post: `https://stats.stackexchange.com/questions/281162/scale-a-number-between-a-range`

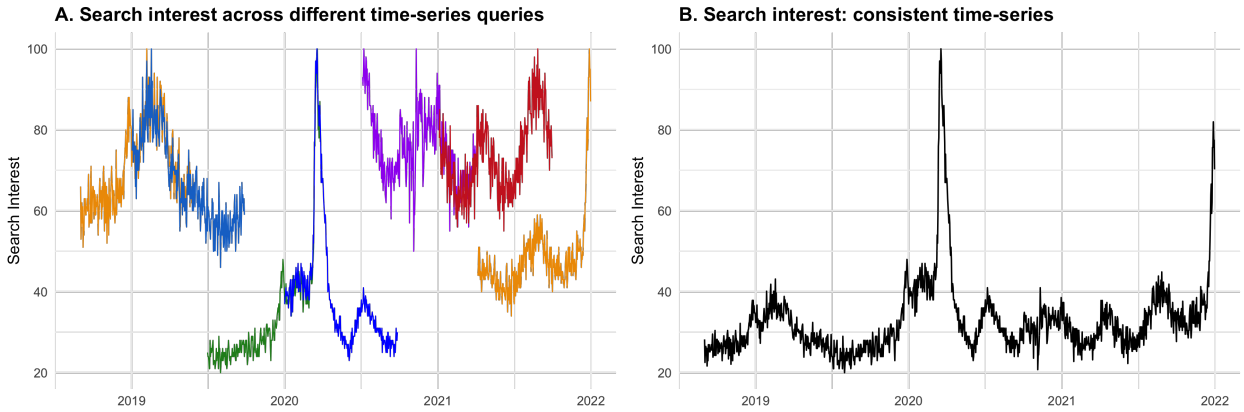

Figure S1: Creating a consistent time series of google search interest for search interest in "fever" for the United States. **Panel A** shows the raw search interest values across queries for search interest across different date ranges. Each query is scaled so its maximum value is 100. **Panel B** shows a consistent time series, creating from scaling values

S4 Correlation and lag between search interest and COVID-19 cases

Table S6 summarizes the distribution of the correlation between search interest and COVID-19 cases across countries as well as the distribution of the lag of COVID-19 cases that resulted in the highest correlation with search interest. Figure S2 compares the distribution of the original correlation and the correlation when using the optimal lag of COVID-19 cases.

Table S6: Correlation between search interest and COVID-19 Cases

Term	Using data in 2020								Using data in 2021							
	Percentile						Max		Percentile						Max	
	Min	5th	25th	50th	75th	95th		N	Min	5th	25th	50th	75th	95th		N
Correlation																
Ageusia	-0.42	-0.2	-0.04	0.09	0.24	0.46	0.66	77	-0.44	-0.2	-0.06	0.08	0.19	0.39	0.74	67
Shortness of Breath	-0.41	-0.18	-0.08	0.04	0.16	0.39	0.58	128	-0.38	-0.18	-0.05	0.11	0.29	0.54	0.97	118
Fever	-0.54	-0.37	-0.14	0	0.14	0.39	0.49	185	-0.32	-0.16	-0.03	0.15	0.33	0.7	0.9	189
Cough	-0.65	-0.34	-0.18	-0.07	0.12	0.28	0.59	179	-0.58	-0.19	0.02	0.17	0.36	0.62	0.92	177
Anosmia	-0.17	-0.1	0.02	0.15	0.33	0.58	0.75	99	-0.32	-0.1	0.01	0.13	0.28	0.57	0.82	87
How to Treat Coronavirus	-0.35	-0.31	-0.14	-0.05	0.23	0.53	0.74	42	-0.06	-0.05	0.08	0.2	0.38	0.57	0.58	32
I Can't Taste	-0.28	-0.18	0.03	0.07	0.26	0.57	0.82	15	-0.18	-0.13	-0.01	0.18	0.3	0.57	0.61	15
Coronavirus	-0.53	-0.47	-0.3	-0.19	-0.07	0.23	0.69	191	-0.37	-0.18	0.02	0.2	0.49	0.72	0.9	198
Covid-19	-0.36	-0.19	-0.05	0.09	0.26	0.5	0.85	191	-0.43	-0.14	0.04	0.2	0.43	0.71	0.88	195
Pneumonia	-0.52	-0.28	-0.13	-0.04	0.16	0.53	0.8	164	-0.39	-0.15	-0.01	0.16	0.39	0.73	0.98	160
I Can't Smell	-0.17	-0.15	0.01	0.18	0.41	0.66	0.76	33	-0.26	-0.05	0.01	0.08	0.29	0.59	0.7	29
Loss of Taste	-0.14	-0.1	0.13	0.34	0.54	0.8	0.93	99	-0.34	-0.06	0.1	0.25	0.42	0.69	0.9	98
Covid Symptoms	-0.2	-0.1	0.11	0.28	0.56	0.75	0.8	132	-0.2	-0.05	0.19	0.39	0.59	0.82	0.95	129
Loss of Smell	-0.19	-0.1	0.12	0.42	0.62	0.82	0.92	104	-0.15	-0.06	0.08	0.3	0.49	0.78	0.9	98
Correlation using best lag																
Ageusia	-0.38	-0.15	0.03	0.21	0.36	0.62	0.77	77	-0.38	-0.07	0.03	0.15	0.31	0.47	0.76	67
Shortness of Breath	-0.3	-0.11	0.02	0.14	0.26	0.46	0.72	128	-0.26	-0.12	0.09	0.22	0.37	0.56	0.97	118
Fever	-0.41	-0.28	-0.06	0.1	0.27	0.47	0.75	185	-0.28	-0.06	0.1	0.24	0.4	0.78	0.94	189
Cough	-0.6	-0.31	-0.12	0.02	0.18	0.4	0.75	179	-0.5	-0.15	0.12	0.27	0.47	0.69	0.95	177
Anosmia	-0.14	-0.06	0.11	0.29	0.44	0.66	0.83	99	-0.19	-0.05	0.11	0.25	0.37	0.58	0.88	87
How to Treat Coronavirus	-0.3	-0.28	-0.1	0.07	0.45	0.71	0.75	42	-0.05	-0.02	0.17	0.3	0.53	0.62	0.69	32
I Can't Taste	-0.22	-0.02	0.14	0.23	0.37	0.63	0.82	15	-0.08	-0.06	0.11	0.26	0.38	0.58	0.61	15
Coronavirus	-0.5	-0.4	-0.25	-0.11	0.04	0.54	0.91	191	-0.28	-0.13	0.09	0.32	0.53	0.74	0.93	198
Covid-19	-0.32	-0.13	0.02	0.19	0.36	0.67	0.86	191	-0.3	-0.09	0.13	0.32	0.51	0.76	0.89	195
Pneumonia	-0.42	-0.25	-0.09	0.06	0.27	0.61	0.87	164	-0.37	-0.07	0.09	0.29	0.5	0.79	0.98	160
I Can't Smell	-0.14	-0.13	0.05	0.32	0.45	0.73	0.84	33	-0.15	0.05	0.14	0.29	0.37	0.65	0.82	29
Loss of Taste	-0.14	-0.06	0.22	0.45	0.63	0.9	0.97	99	-0.14	-0.01	0.2	0.31	0.49	0.74	0.97	98
Covid Symptoms	-0.17	-0.05	0.23	0.43	0.67	0.83	0.95	132	-0.2	0.04	0.3	0.49	0.67	0.88	0.99	129
Loss of Smell	-0.17	-0.07	0.27	0.53	0.74	0.91	0.95	104	-0.13	-0.01	0.21	0.4	0.54	0.82	0.97	98
Lag with best correlation																
Ageusia	-21	-21	-21	-10	8	21	21	77	-21	-21	-17.5	-1	16	21	21	67
Shortness of Breath	-21	-21	-18	-10	0	21	21	128	-21	-21	-11	2	17	21	21	118
Fever	-21	-21	-19	-8	4	21	21	185	-21	-21	-16	-6	5	21	21	189
Cough	-21	-21	-18	-8	2.5	21	21	179	-21	-21	-17	-7	2	21	21	177
Anosmia	-21	-21	-20.5	-12	-4	21	21	99	-21	-21	-16.5	-4	11.5	21	21	87
How to Treat Coronavirus	-21	-21	-21	-14.5	-5.75	11.8	21	42	-21	-21	-18	-9	3	17.15	21	32
I Can't Taste	-21	-21	-21	-14	-0.5	21	21	15	-21	-21	-19	-12	2.5	11.2	14	15
Coronavirus	-21	-21	-21	-19	-9.5	-2	21	191	-21	-21	-12	-3	5	21	21	198
Covid-19	-21	-21	-21	-16	-7	6	21	191	-21	-21	-12.5	-3	6	21	21	195
Pneumonia	-21	-21	-15.25	-8	5	21	21	164	-21	-21	-14	-3	9	21	21	160
I Can't Smell	-21	-21	-17	-8	1	19.2	21	33	-21	-21	-12	-2	14	21	21	29
Loss of Taste	-21	-21	-21	-13	-4.5	21	21	99	-21	-21	-10.75	-2.5	8	21	21	98
Covid Symptoms	-21	-21	-21	-12.5	-5	12	20	132	-21	-21	-11	-5	1	19	21	129
Loss of Smell	-21	-21	-18.25	-12	-2.75	18.55	21	104	-21	-21	-14	-6.5	2	21	21	98

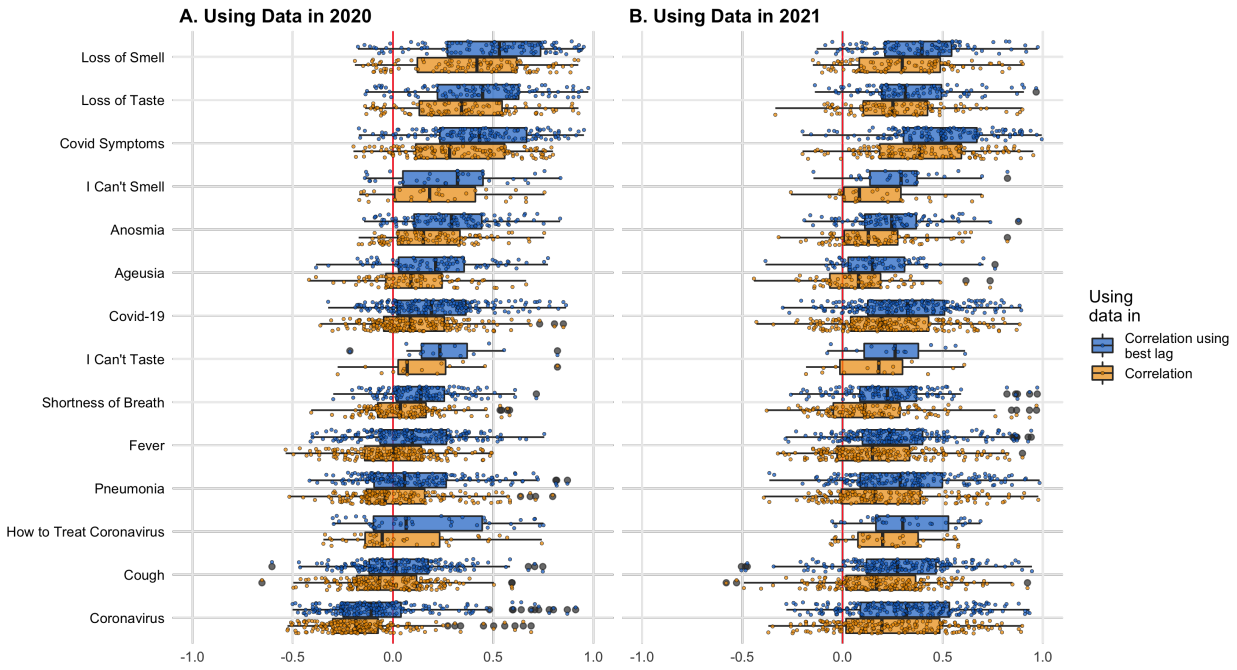

Figure S2: Distribution of correlation between search interest and COVID-19 cases using the original correlation and the correlation when using the lagged value of COVID-19 cases that produced the highest correlation. The boxplots include: center line, median; box limits, upper and lower quartiles; whiskers, 1.5x interquartile range; points beyond whiskers, outliers.

S5 Map of correlations of Search Interest in "Loss of Smell" and "Fever" with COVID-19 Cases

Figure S3 shows a map of the correlations using "Loss of Smell" and a more general symptom ("Fever"); the figure illustrates how the correlation between COVID-19 cases and search interest in "Loss of Smell" is strong throughout different geographic regions. In addition, the figure illustrates that while search interest in more general symptoms such as "Fever" tend to have a lower correlation, these terms tend to have data across more countries—where in some countries, the search terms still work well.

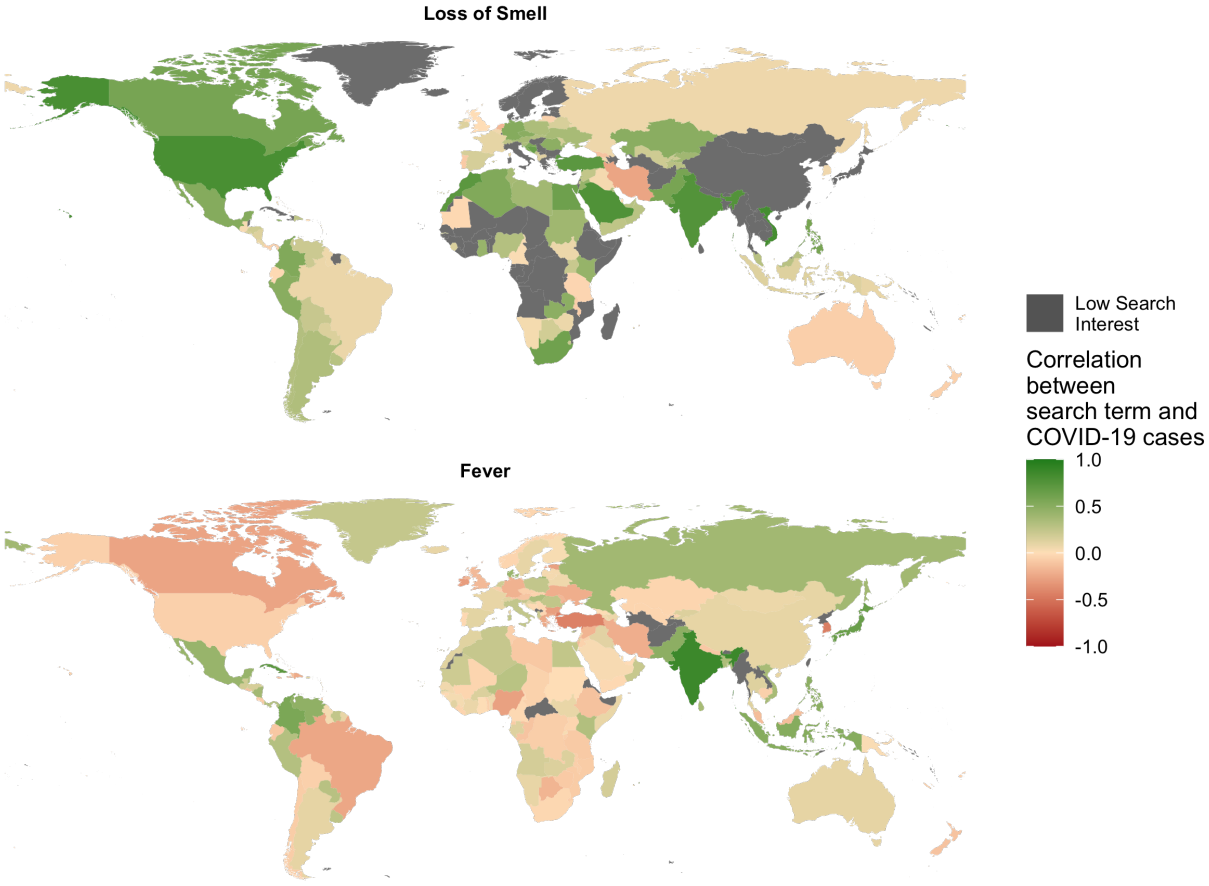

Figure S3: Trends between search interest and COVID-19 Cases for Select Countries

S6 Search interest for loss of smell and COVID-19 cases for all countries with available data

Figure S4 shows trends in search interest in "Loss of Smell" and COVID-19 cases for all countries with available data.

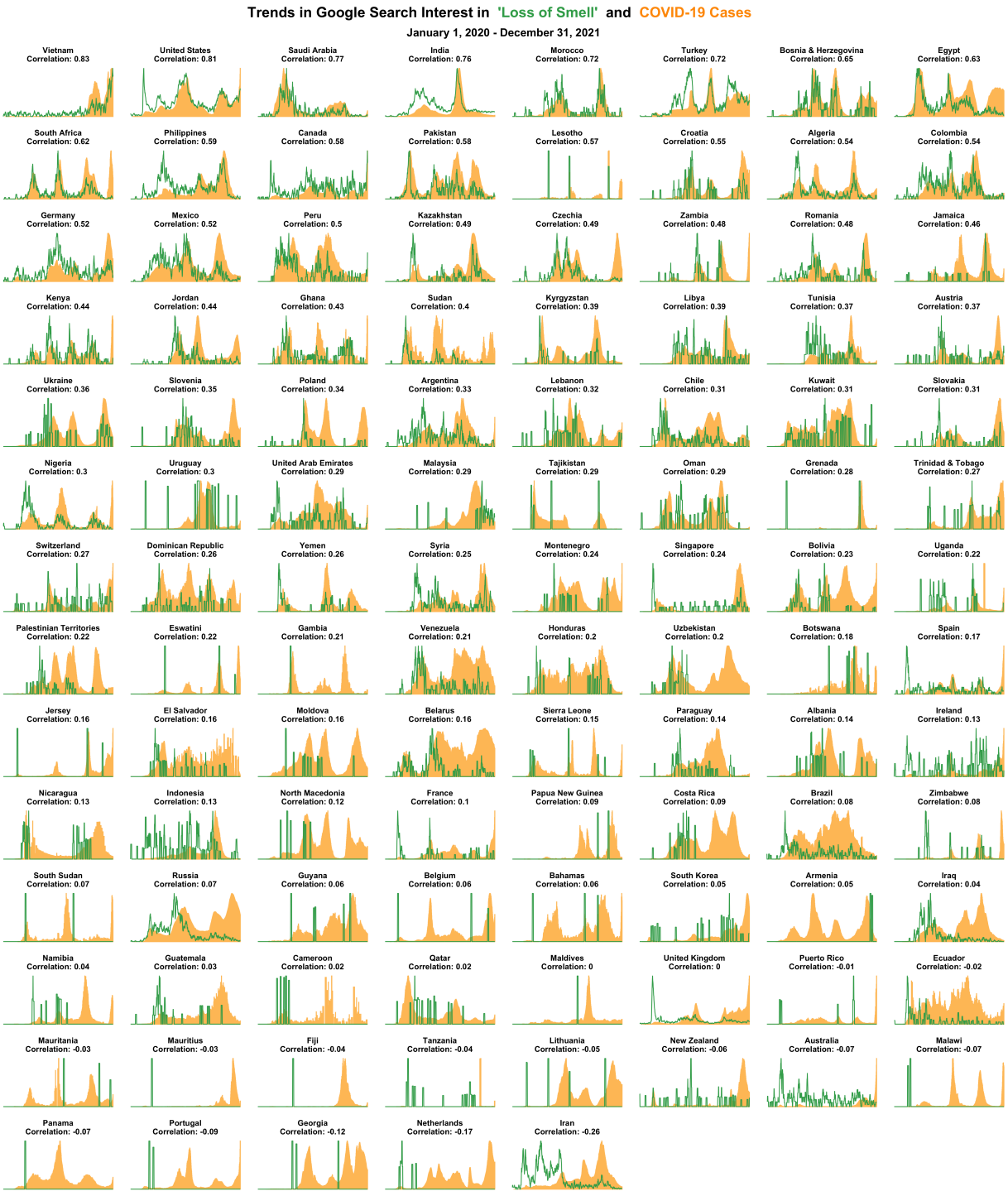

Figure S4: Trends between search interest and COVID-19 Cases for Select Countries

S7 Trends in Search Interest and COVID-19 Cases Among Countries with Recent Surges in Cases

Figure S5 shows trends in search interest in "Loss of Smell", a more general symptom search term ("Fever"), a more general COVID search term ("COVID Symptoms"), and COVID-19 cases for six example countries that saw COVID-19 cases surge towards the end of 2021, in many cases driven by the Omicron variant. The figure illustrates mixed results in search interest moving with the recent increase in COVID-19 cases. For example, search interest in "Loss of Smell" increases with the recent rise in cases in the United States, but not other countries; in addition, search interest in "Fever" increases with the recent rise in cases in France, Italy, and the United States, but not other countries. However, "COVID Symptoms" increases with the recent rise in cases in all countries considered.

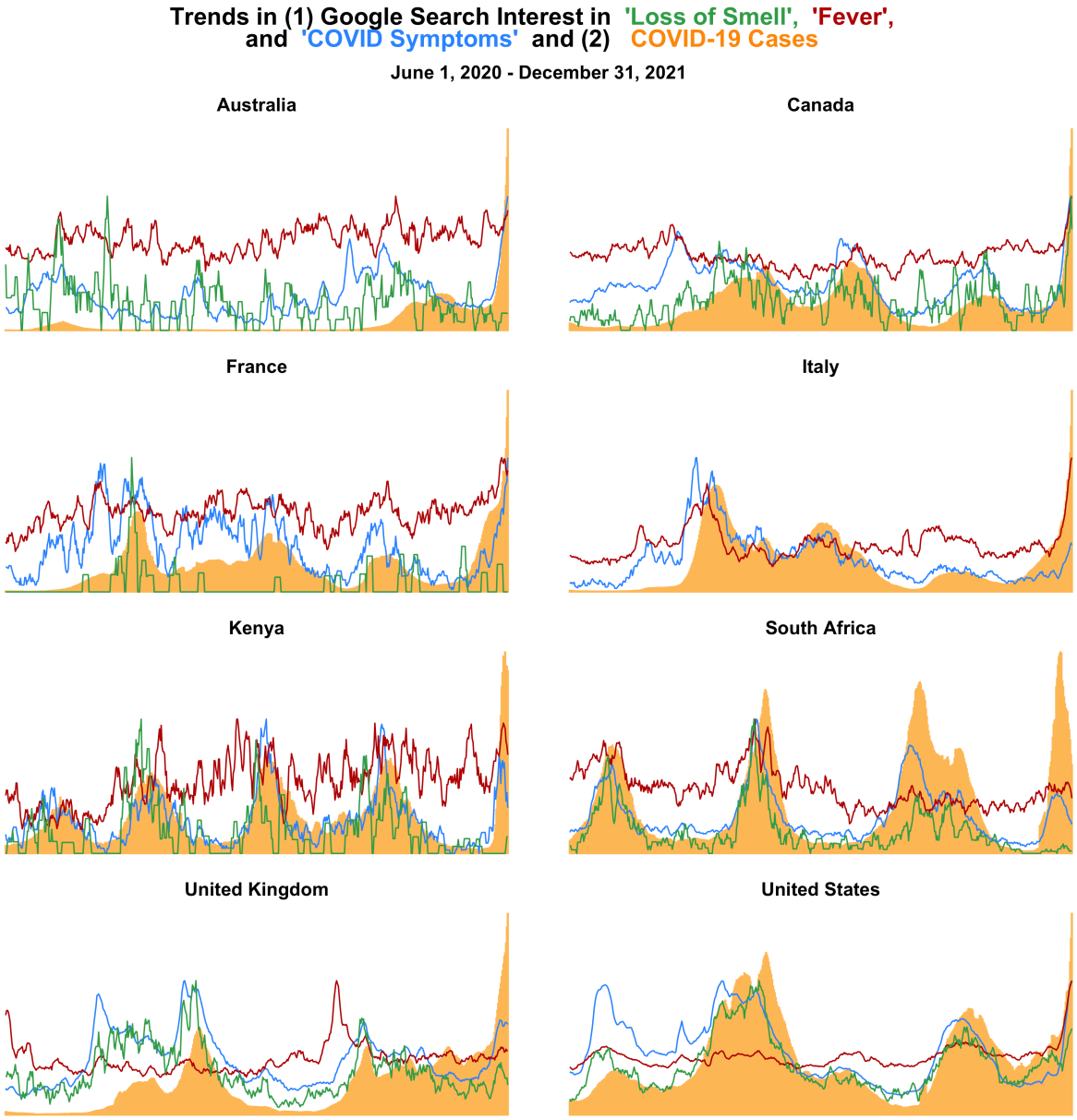

Figure S5: Trends between search interest and COVID-19 Cases for Select Countries

S8 Explaining Correlation Between Search Interest and COVID-19 Cases: Additional Results

We estimate OLS models explaining the correlation between "Loss of Smell" and COVID-19 cases with select covariates. The results show that GDP per capita, percent of the population using internet and the number of mobile cell phone subscribers per 100 are not not associated with the correlation. Here, we test whether these results hold using the correlation between "Loss of Taste" and COVID-19 cases, and "COVID Symptoms" and COVID-19 cases.

Tables S7 and S8 show regression results using the correlation with "Loss of Taste" and "COVID Symptoms" respectively and figures S6 - S9 show scatterplots between all dependent variables and covariates. Results using "Loss of Taste" are nearly identical to those using "Loss of Smell." Results using the correlation between "COVID Symptoms" and COVID-19 cases show that GDP per capita is associated with a 3% increase ($p < 0.1$) in the correlation without additional covariates (column 4) and with a 11% increase ($p < 0.05$) in the correlation when including additional covariates (column 5). While these results show that more wealthly countries tend to see stronger correlations, these models explain—at best—10% of the variation in the correlation. Figure S9 emphasizes that while there is a slight positive association between GDP per capita and the correlation between "COVID Symptoms" and COVID-19 cases, the association is rough—with many countries with low GDP per capita seeing high correlations.

	Dependent variable:									
	Correlation					Best Lag				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total COVID-19 Cases, log	0.04***				0.06***	−0.07				−0.63
	(0.01)				(0.02)	(0.56)				(0.81)
Per Pop. Using Internet		0.0001			−0.003		0.01			−0.11
		(0.001)			(0.002)		(0.05)			(0.11)
Mobile Cell Sub. per 100			0.001		−0.0001			0.03		−0.02
			(0.001)		(0.001)			(0.04)		(0.05)
GDP Per Cap, Log				0.02	0.02				0.97	2.80
				(0.02)	(0.04)				(0.79)	(1.92)
Constant	−0.23	0.25***	0.17*	0.10	−0.52*	−8.27	−8.52**	−12.48***	−17.88**	−14.98
	(0.15)	(0.08)	(0.09)	(0.15)	(0.29)	(7.43)	(3.80)	(4.36)	(7.13)	(13.89)
Observations	105	80	97	103	79	105	80	97	103	79
Adjusted R^2	0.08	-0.01	-0.003	-0.001	0.11	-0.01	-0.01	-0.004	0.01	-0.02

Table S7: Explaining correlation between search interest in "Loss of Taste" and COVID-19 Cases

	Dependent variable:									
	Correlation					Best Lag				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total COVID-19 Cases, log	0.03***				0.04**	−0.71**				−1.44**
	(0.01)				(0.02)	(0.34)				(0.56)
Per Pop. Using Internet		0.001			−0.01***		−0.03			−0.09
		(0.001)			(0.003)		(0.04)			(0.09)
Mobile Cell Sub. per 100			0.0003		0.0004			−0.03		−0.03
			(0.001)		(0.001)			(0.03)		(0.04)
GDP Per Cap, Log				0.03*	0.12***				−0.42	2.72*
				(0.02)	(0.04)				(0.58)	(1.60)
Constant	−0.001	0.27***	0.27***	0.05	−0.89***	0.94	−5.30*	−4.85	−4.16	−4.08
	(0.12)	(0.08)	(0.10)	(0.14)	(0.31)	(4.23)	(2.68)	(3.41)	(5.24)	(11.23)
Observations	138	95	113	131	92	138	95	113	131	92
Adjusted R^2	0.04	-0.01	-0.01	0.02	0.12	0.02	-0.003	-0.002	-0.004	0.05

Table S8: Explaining correlation between search interest in "Loss of Smell" and COVID-19 Cases

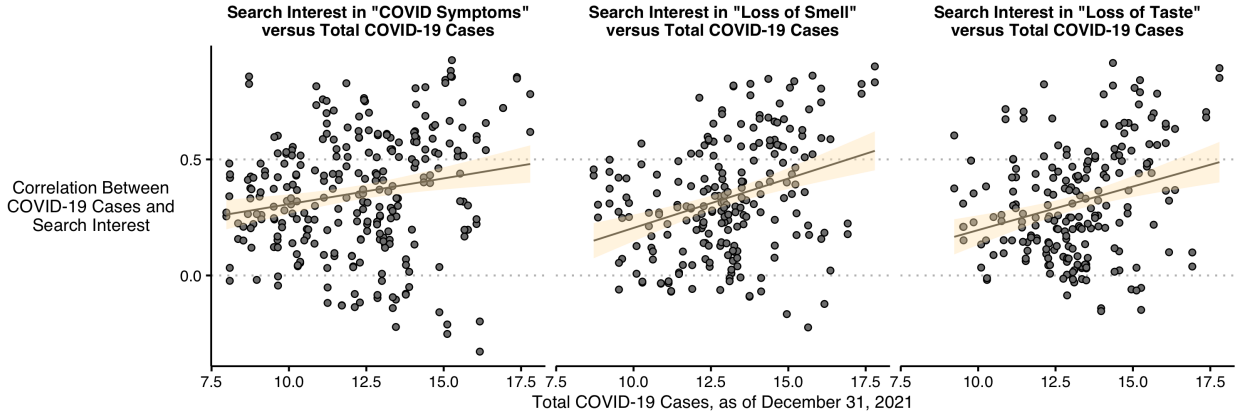

Figure S6: Scatterplots showing association between (1) correlation of search interest and COVID-19 cases and (2) total COVID-19 cases as of December 31, 2021, for search interest in "COVID Symptoms", "Loss of Smell", and "Loss of Taste."

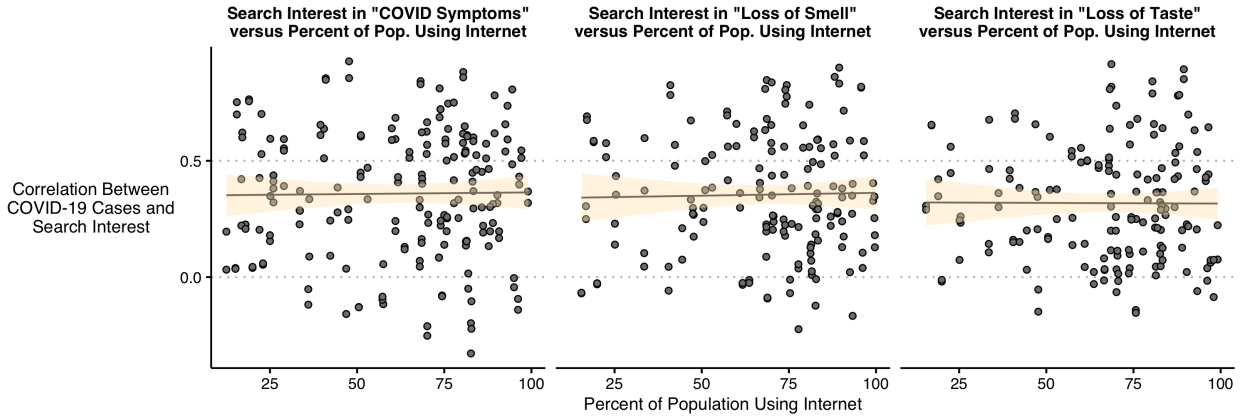

Figure S7: Scatterplots showing association between (1) correlation of search interest and COVID-19 cases and (2) percent of the population using internet, for search interest in "COVID Symptoms", "Loss of Smell", and "Loss of Taste."

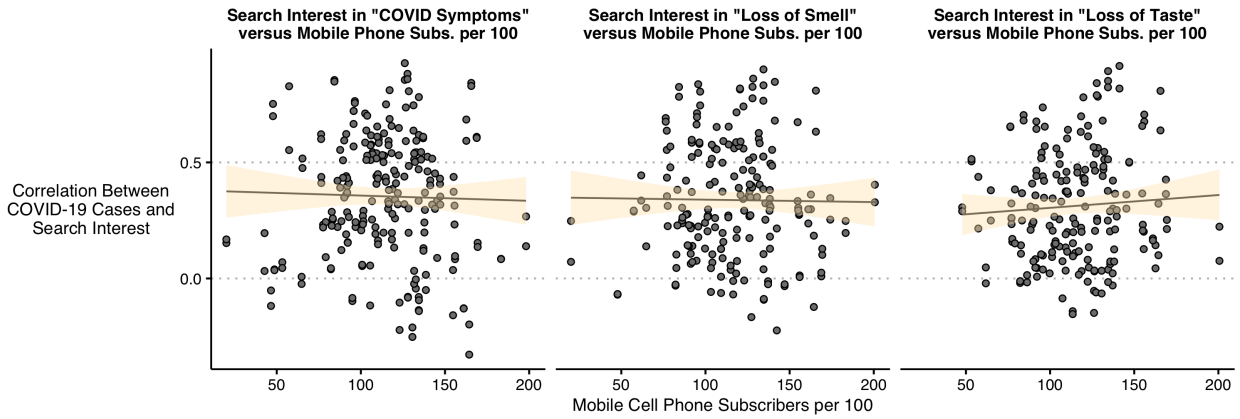

Figure S8: Scatterplots showing association between (1) correlation of search interest and COVID-19 cases and (2) mobile cell phone subscribers per 100, logged, for search interest in "COVID Symptoms", "Loss of Smell", and "Loss of Taste."

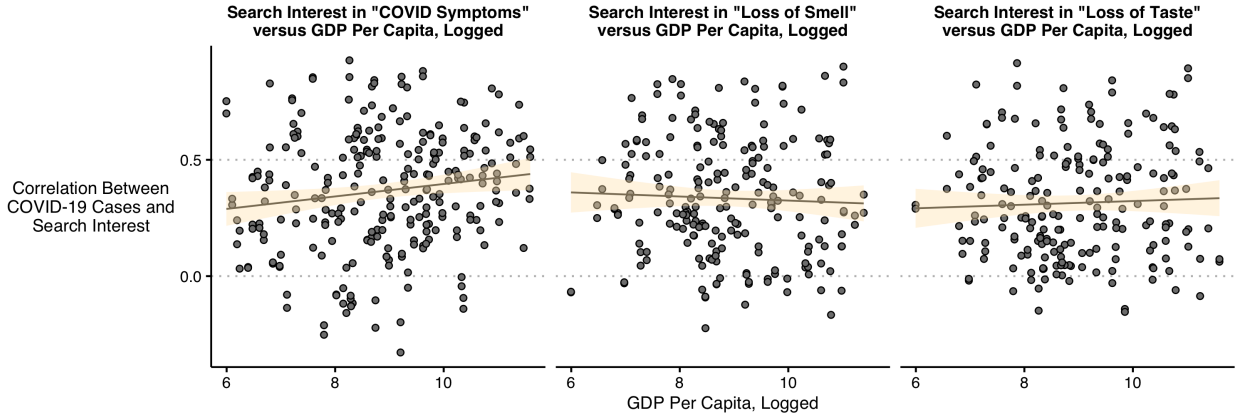

Figure S9: Scatterplots showing association between (1) correlation of search interest and COVID-19 cases and (2) GDP per capita, logged, for search interest in "COVID Symptoms", "Loss of Smell", and "Loss of Taste."

S9 Impact of Containment Policies on Search Interest: Event Study Results

Our primary approach to estimate the impact of containment policies on search interest relies on a difference-in-difference approach. As a robustness check, we also estimate results relying on an event-study approach; figure S9 shows results using data 90 days before and after the first containment policy for each country, where results are largely consistent with difference-in-difference results.

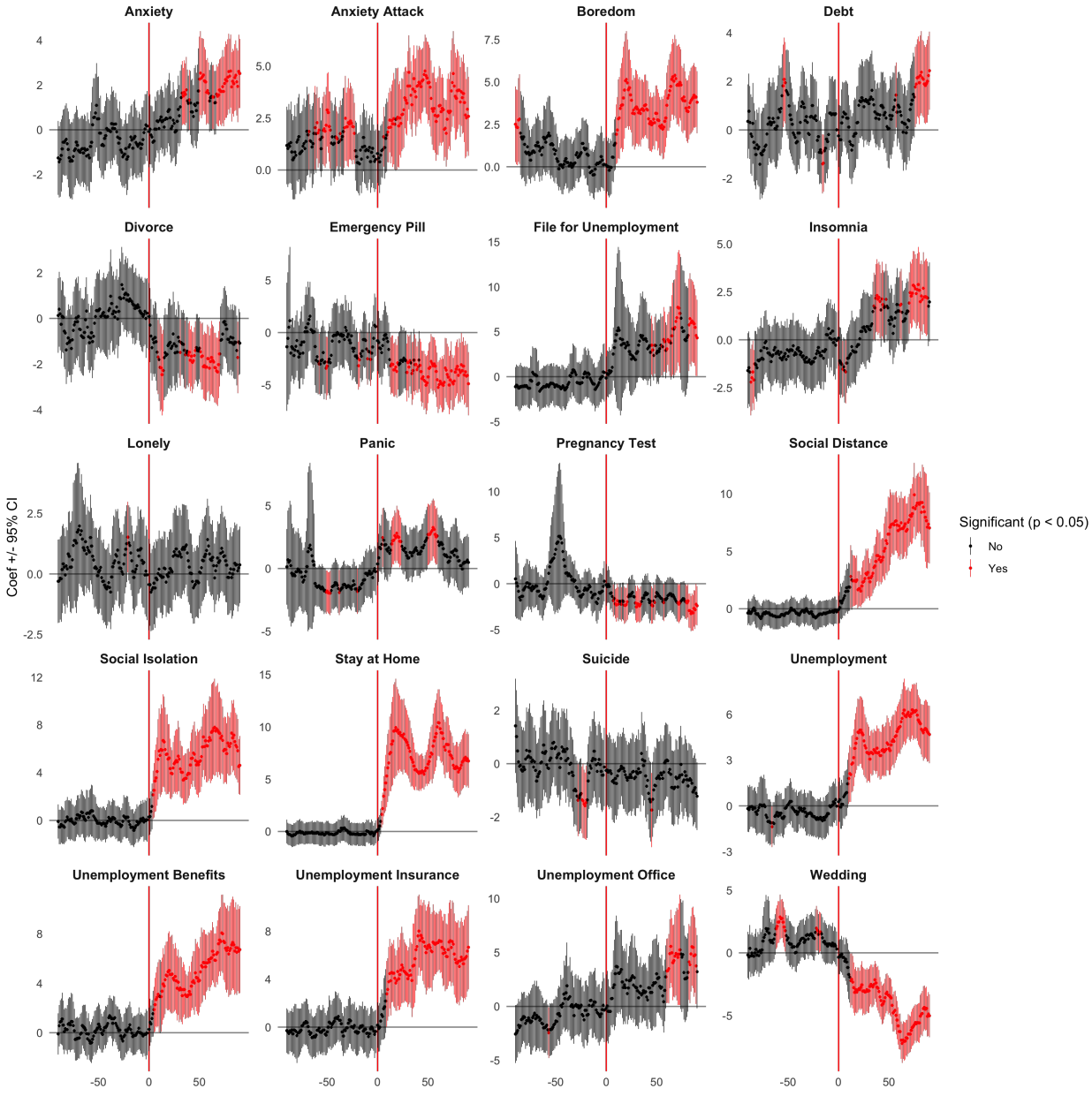

Figure S10: Event study examining the impact of containment policies on search interest. 95% confidence intervals shown for each coefficient.

S10 Impact of Containment Policies on Search Interest: Sensitivity Analysis Across Different Day Thresholds

To estimate the impact of containment policies on search interest, our primary model relies on using days three months (90 days) before and after the date of the first containment policy. This section shows results using 30, 60 and 120 day thresholds.

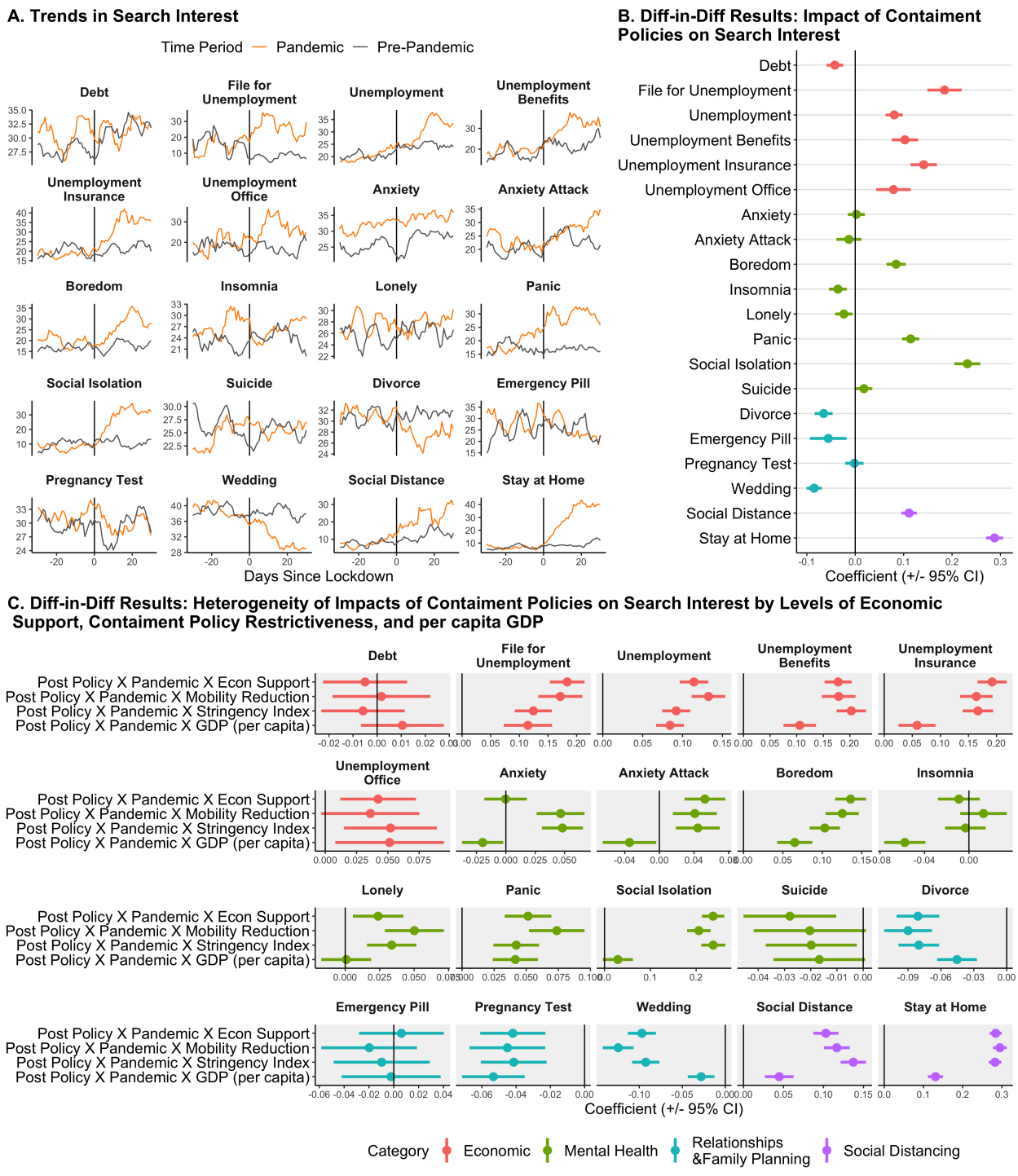

Figure S11: Impact of COVID-19 Policies on Search Interest using a 30 day threshold. Panel A shows average search interest across all countries with available data on Google Trends. Before averaging, search interest values for each country are standardized between 0 and 100. **Panel B** shows difference-in-differences results showing the overall impact of containment policies across search terms. Only the difference-in-differences coefficient is reported. **Panel C** shows difference-in-differences results that explore heterogeneity of impacts across containment policy restrictiveness, economic support, and GDP per capita. In panels B and C, point estimates and 95% confidence intervals are shown.

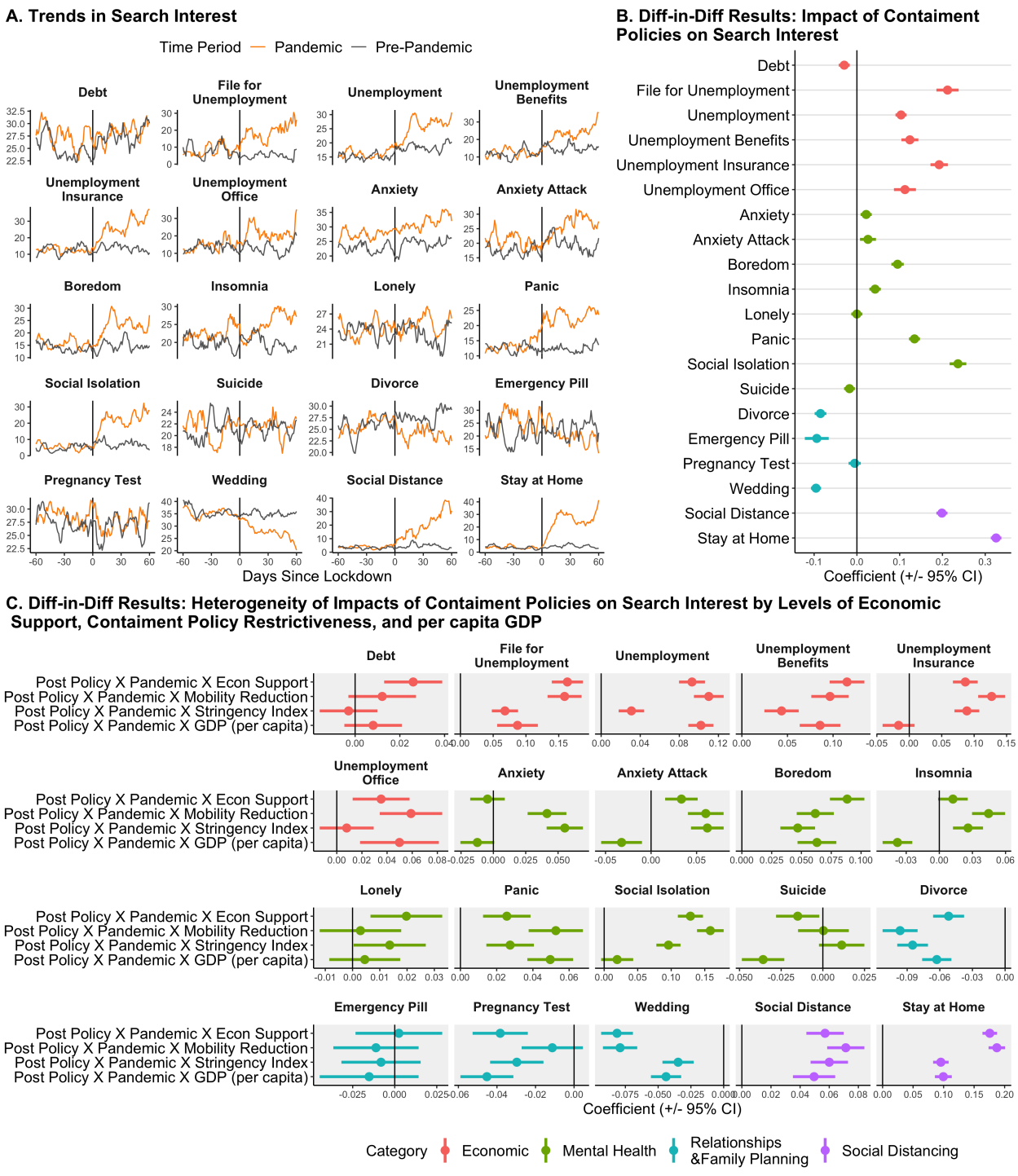

Figure S12: Impact of COVID-19 Policies on Search Interest using a 60 day threshold. Panel A shows average search interest across all countries with available data on Google Trends. Before averaging, search interest values for each country are standardized between 0 and 100. **Panel B** shows difference-in-differences results showing the overall impact of containment policies across search terms. Only the difference-in-differences coefficient is reported. **Panel C** shows difference-in-differences results that explore heterogeneity of impacts across containment policy restrictiveness, economic support, and GDP per capita. In panels B and C, point estimates and 95% confidence intervals are shown.

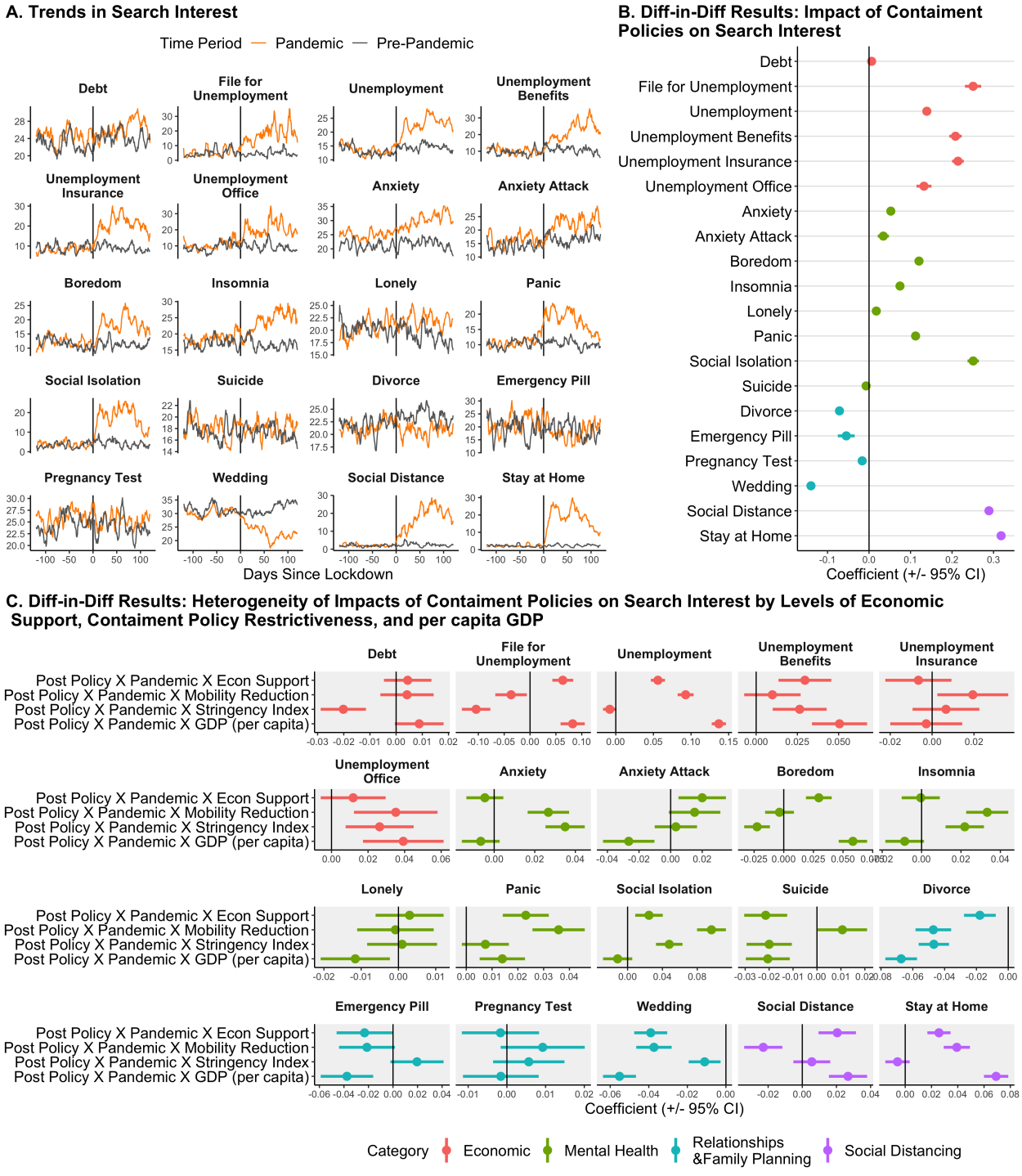

Figure S13: Impact of COVID-19 Policies on Search Interest using a 120 day threshold. Panel A shows average search interest across all countries with available data on Google Trends. Before averaging, search interest values for each country are standardized between 0 and 100. **Panel B** shows difference-in-differences results showing the overall impact of containment policies across search terms. Only the difference-in-differences coefficient is reported. **Panel C** shows difference-in-differences results that explore heterogeneity of impacts across containment policy restrictiveness, economic support, and GDP per capita. In panels B and C, point estimates and 95% confidence intervals are shown.

S11 Correlation of Daily Vaccination Rates and Search Interest, Separated by per Capita GDP

Figure S14 shows the distribution of within-country correlations of daily vaccination rates and search interest across vaccine related search terms, where we separately show the distributions across higher and lower income countries (we distinguish higher and lower income countries using the median per capita GDP across countries).

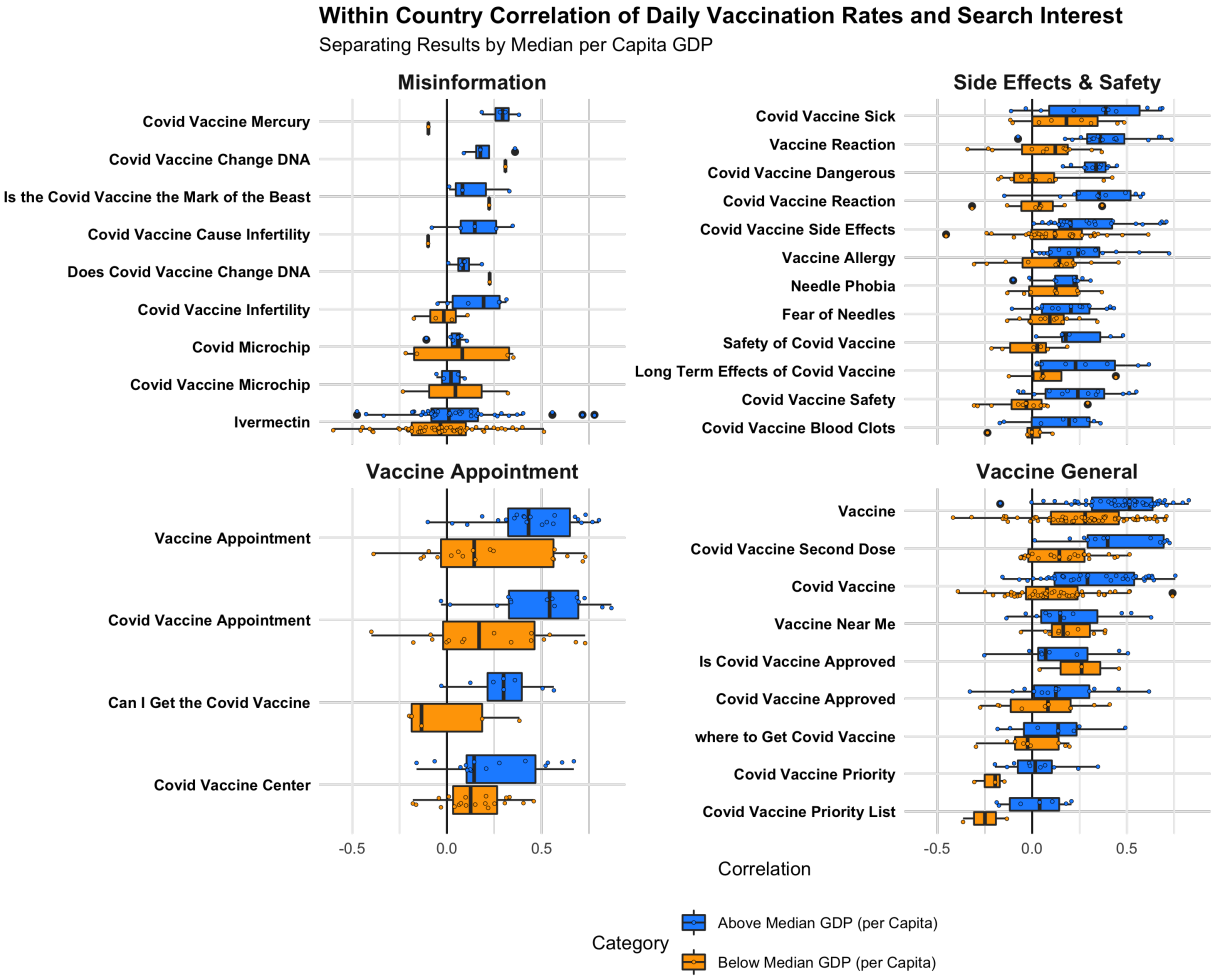

Figure S14: Distribution of within country correlation of daily vaccination rates and search interest, separating results by median per capital GDP. The boxplots include: center line, median; box limits, upper and lower quartiles; whiskers, 1.5x interquartile range; points beyond whiskers, outliers.

References

[1] Google Help. FAQ about google trends data. https://support.google.com/trends/answer/4365533?hl=en. Accessed: 2022-01-15.