The Impact of COVID-19 on Conspiracy Attitudes and Risk Perception in Italy: an Infodemiological Survey through Google Trends.

Alessandro Rovetta,

Mensana srls, Research and Disclosure Division,

Via Malta 12 –25124 Brescia, Italy.

Redeev Technological and Scientific Research,

Via San Pasquale a Chiaia 83, Naples, Italy.

Email: rovetta.mresearch@gmail.com

Phone: 39-3927112808

ORCID: 0000-0002-4634-279X

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Conflict of Interest

None declared.

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Abstract

Background: The novel coronavirus disease (COVID-19) caused the worst international crisis since World War II. Italy was one of the countries most affected by both the pandemic and the related infodemic. The success of anti-COVID-19 strategies and future public health policies in Italy cannot prescind from containment of fake news and divulgation of correct information.

Objective: The aim of this paper is to analyze the impact of COVID-19 on conspiracy attitudes and risk perception of Italian web users.

Methods: Google Trends was used to monitor users' web interest in specific topics, such as conspiracy hypotheses, vaccine side effects, and pollution/climate change. The keywords adopted to represent these topics were mined from Bufale.net – an Italian website specialized in detecting online hoaxes – and Google Trends suggestions (i.e., related topics and related queries). Relative search volumes of the timelapse 2016-2020 (pre-COVID-19) and 2020-2021 (post-COVID-19) were compared through percentage difference ($\Delta\%$) and Welch's t-test (t). When data series were not stationary, other ad-hoc criteria were used. The trend slopes were assessed through Sen's Slope (SS). The significance thresholds have been indicatively set at $P = .05$ and $t = 1.9$.

Results: The COVID-19 pandemic drastically enforced Italian netizens' conspiracy attitudes ($\Delta\% \in [60, 288]$, $t \in [6, 12]$). The regional web interest towards conspiracy-related queries has increased and become more homogeneous compared to the pre-COVID-19 period ($\overline{RSV} = 80 \pm 2.8$, $t_{min} = 1.8$, $\Delta_{min\%} = +12.4$, $min \Delta_{SD\%} = -25.8$). Besides, a growing trend in web interest in the infodemic YouTube channel "ByoBlu" has been highlighted. The web interest in fake news has increased more than that in anti-hoax services ($t_1 = 11.3$ vs $t_2 = 4.5$, $\Delta_1 = +157.6$ vs $\Delta_2 = +84.7$). Equivalently, the web interest in vaccine side effects exceeded that in pollution/climate change ($SS_{vac} = 0.22$, $P < .001$ vs $SS_{pol} = 0.05$, $P < .001$, $\Delta\% = +296.4$).

Conclusions: COVID-19 has given a significant boost to online conspiracy attitudes in Italy. In particular, the average web interest in conspiracy hypotheses has increased and become more uniform across regions. The pandemic accelerated an already growing trend in users' interest towards some fake news sources, including the 500,000 subscribers YouTube channel "ByoBlu" (canceled for disinformation in March 2021). The risk perception related to COVID-19 vaccines has been so distorted that vaccine side effects-related queries outweighed those relating to pollution and climate change, which are much more urgent issues. Based on these findings, it is necessary that the Italian authorities implement more effective infoveillance systems and communication by the mass media is less sensationalistic and more consistent with the available scientific evidence. In this context, Google Trends can be used to monitor the users' response to specific infodemiological countermeasures. Further research is needed to understand the psychological mechanisms that regulate risk perception.

Keywords: COVID-19, fake news, Google Trends, infodemiology, Italy, risk perception

Introduction

The coronavirus disease 2019 (abbreviated in COVID-19) was responsible for one of the dramatic global crises after World War II. To date (April 24, 2021), the official global toll is 144 million cases and 3.1 million deaths [1]. Such a pandemic has also triggered a vast infodemic capable of seriously damaging the economy and sanitary system of many countries, as well as favoring the spread of the novel coronavirus itself [2]. Specifically, an infodemic is defined as an excessive amount of unfiltered information concerning a problem such that the solution is made more difficult [3]. As reported by the World Health Organization (WHO), this phenomenon can intensify or lengthen outbreaks. For this reason, a huge infoveillance effort has been made to study the information circulating on the web and contain the spread of fake news [4]. In this context, 132 nations worldwide signed a document to guarantee their commitment to the battle against disinformation and misinformation [5]. On the operational level, infodemic management takes place through 4 key points: i) listening to community concerns and questions, ii) promoting understanding of risk and health expert advice, iii) building resilience to misinformation, iv) engaging and empowering communities to take positive action [2]. This paper focuses on points ii) and iii) as concerns Italy, one of the nations most affected by COVID-19 [1]. In particular, this study aims to analyze and quantify the impact of COVID-19 on Italian netizens' risk perception and conspiracy attitudes through Google Trends, an infoveillance tool provided by GoogleTM that returns users' web interest in specific topics in the form of normalized values called "relative search volumes" (RSVs) [6]. Google Trends has been exploited extensively in the scientific community to conduct infodemiological, medical, psychological, economic, and even epidemiological studies [7-12]. Indeed, although the media can influence users' web searches [13], Google Trends provides valuable details on the dynamics of users' online interests (including the influence of the media on collective thinking) [14, 15].

At present, the success of the vaccination campaign is crucial in the fight against COVID-19 [16, 17]. Conspiracy hypotheses, inadequate risk perception, and unjustified fears have already undermined non-pharmacological containment measures and can reduce the effectiveness of pharmacological ones [18]. Furthermore, these factors can compromise the management of equally serious problems such as pollution and climate change (often linked to COVID-19 incidence and mortality) [19-21]. Therefore, such a scenario requires careful surveillance of the online information flow as well as thoughtful communication. As we will show in this research, Google Trends can help achieve this goal.

Methods

Data collection

For each topic appropriate keywords were selected as explained in the following subsections. Each keyword was searched on Google Trends under the category "all categories". The timelapse was set at five years (April 21, 2016 – April 21, 2021). Only the most relevant queries were included in the results (i.e. $\overline{RSV} > 1$). All keywords were collected for at least 7 consecutive days in order to highlight potential anomalies and significant variations [22].

- Pre-existing fake news

Pre-existing fake news and disinformation channels were mined from the specialized anti-hoaxes website "Bufale.net" [23]. Four keywords that can represent the main conspiracy-related web interests on Google Trends were identified: "cospirazione + nuovo ordine mondiale + complotto" (conspiracy + new world order + plot), "byoblu" (a 500,000 subscribers YouTube channel canceled in March 2021 for disinformation), "Maurizio Blondet" (an Italian journalist who supports conspiracy hypotheses), and "luogocomune" (a Facebook page sharing conspiracy hypotheses).

- Risk perception

RSVs of the query "fake news + bufale + notizie false" (fake news + hoaxes + false news) and the previous queries (Pre-existing fake news) were compared. By doing so, it was possible to observe the impact of the pandemic on web interest in anti-hoax services and hoaxes themselves. The selection of the queries with the highest RSVs was conducted by consulting related topics and related queries provided by Google Trends. The same procedure was carried out for the queries "vaccini effetti collaterali + vaccino effetti collaterali" (vaccine side effects + vaccine side effects) and "inquinamento + cambiamento climatico" (pollution + climate change) queries. In this way, it was possible to evaluate the web interest in two very distant topics in terms of health risk and incidence [24-26].

Statistical Analysis

- Welch's t-test

Welch's t-test was used independently of the dataset distribution thanks to the central limit theorem ($N > 30$, with N number of measures). The difference between the two mean values was considered significant indicatively when $t > 1.9$.

- Percentage change

The percentage change $\Delta\%$ was calculated through the formula $[y(T_2) - x(T_1)]/x(T_1) \cdot 100$, where T_i is a specific timelapse.

- Mean values

All mean values were calculated using the standard arithmetic mean and presented through the notation $AV \pm SEM$, where SEM represents the standard error of the mean. When $N < 30$, the Shapiro-Wilk test was performed to assess the goodness of the mean value as a statistical measure.

- Data series analysis

All data series were graphed. To signal the presence/absence of trends, augmented Dickey-Fuller (ADF) and Mann-Kendall + Sen's Slope (MK + SS) tests were adopted. The same tests were used to evaluate datasets stationarity. Calculations were performed with Microsoft Excel 2021 software through the Real-Statistics 2021 package (Supplementary File 1). The optimal lag was determined using the Schwert criterion.

- Data series comparison

To provide a quantitative estimate of the effect of COVID-19 on web queries, RSV trends over the last five years (21 April 2016 – 21 April 2021) were analyzed. As shown in a previous paper, Italian netizens showed a marked interest in the COVID-19 pandemic only when this became a direct national problem [27]. Therefore, the timelapse "21 April 2016 - 16 February 2020" (period 1) and "16 February 2020 - 21 April 2021" (period 2) were compared. When period 1 turned out to be stationary or contained a negative trend, t and $\Delta_{\%}$ have been calculated. When period 1 contained a stationary positive trend, the trend slopes of period 1 and a specific subperiod "16 February 2020 - x" of period 2 were compared by $\Delta_{\%}$; such a subperiod was selected by observing the region of the graph in which a possible positive level-shift occurred. Period 1 data were then linearly, quadratically, or sigmoidally interpolated, depending on which monotone function minimized the statistical errors. Period 2 data were interpolated through a polynomial function of 9th degree. Finally, $\Delta_{\%}$ was calculated between the areas subtended by the two curves after February 16, 2020 ($\Delta A_{\%}$). These were calculated using a definite integral between weeks 201 and 264. When period 1 contained a positive level-shift but was piecewise quasi-stationary, t and $\Delta_{\%}$ were calculated considering only the last quasi-stationary subperiod.

- P-values

P-values were used as graded measures of evidence against the null hypothesis. An indicative threshold has been set at $P = .05$; however, exact P-values for ADF and MK+SS were reported in Supplementary File 1.

Results

Web interest in pre-existing fake news

The impact of COVID-19 on conspiracy-related queries RSVs was evident (Figure 1): in particular, $\Delta_{1\%} = +102.5$, $t_1 = 6.3$; $\Delta_{2\%} = +288.2$, $t_2 = 11.5$; $\Delta A_{3\%} = +10.2$; $\Delta_{4\%} = +60.6$, $t_4 = 6.2$.

Figure 1. Conspiracy-related web relative search volumes (RSV) from April 21, 2016, to April 21, 2021 (Italy). Y-axis = RSV.

It is relevant that COVID-19 national outbreak has influenced the RSV trend even after the end of the first lockdown (May 2020). Indeed, Figure 1 shows a permanent level shift for all the investigated web queries.

Regional interest in conspiracy-related keyword 1 decreased on average during 2016-2020 timelapse, from 71 ± 4.2 to 52 ± 4.1 (Table 1). From 2020 to 2021, the increase in RSV was manifest and common to all regions ($\overline{RSV} = 80 \pm 2.8$, $t_{min} = 1.8$, $\Delta_{min\%} = +12.4$; $t_{max} = 5.7$, $\Delta_{max\%} = +54.6$). Over the period 2016-2020, the percentage standard deviation varied in the range [22.1, 32.6], while it reached an absolute minimum of 14.4 during the COVID-19 pandemic. This fact shows that web interest in conspiracies has also become more homogeneous across regions. No correlation was sought as data was subject to a strong dependence on the day of collection [25]; however, the mean values and standard deviations never changed significantly ($t_{max} = 0.4$).

Region	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
Abruzzo	100	76	38	53	67
Basilicata					
Calabria	48	61	80	27	78
Campania	62	69	59	44	75
Emilia-Romagna	74	70	77	68	80
Friuli-Venezia Giulia	91	68	39	100	100
Lazio	64	85	74	51	84
Liguria	81	100	52	69	89
Lombardia	85	75	63	43	86
Marche	73	68	64	62	91
Molise					
Piemonte	56	75	94	58	88
Puglia	70	78	45	49	67
Sardegna	78	36	100	41	95
Sicilia	80	77	62	43	69
Toscana	84	75	72	44	80
Trentino-Alto Adige	26	41	27	29	54
Umbria	70	82	87	49	77
Valle d'Aosta					
Veneto	72	54	72	52	84
AV	71,4	70,0	65,0	51,9	80,2
SD	17,2	15,5	20,3	16,9	11,5
SD%	24,1	22,1	31,2	32,6	14,4
SEM	4,2	3,8	4,9	4,1	2,8
SEM%	5,9	5,4	7,6	7,9	3,5
Shapiro-Wilk P	1,50E-04	0,18	0,97	0,05	0,93

Table 1. “Conspiracy + New World Order + Plot” web relative search volumes (RSV) year by year from 2016 to 2021 (Italian regions). AV = average value, SEM = standard error of the mean.

On the contrary, the web interest in the ByoBlu disinformation channel has always been compatible during 2016-2021 ($t \in [-1.3, 1.1]$, $\Delta_{\%} \in [-16.3, +21.8]$, $t_{20-21} = -0.1$, $\Delta_{20-21} = -1.0$, Supplementary File 1). Since Figure 1 witnesses a substantial increase in national searches, it is evident that the query "byoblu" was searched more in some regions than others. By analyzing the regional trends one by one, it can be observed that the "byoblu" web interest has increased over time except for Basilicata and Molise (Figure 2). Although a growing trend was already present, the novel coronavirus seems to have strongly impacted RSVs in Campania ($\Delta_{20-21\%} = +93.3$ vs $\Delta_{19-20\%} = +63.8$), Friuli-Venezia Giulia ($\Delta_{20-21\%} = +187.6$ vs $\Delta_{19-20\%} = +59.0$), Lazio ($\Delta_{20-21\%} = +95.7$ vs $\Delta_{19-20\%} = +15.8$), Trentino-Alto Adige ($\Delta_{20-21\%} = +173.2$ vs $\Delta_{19-20\%} = +4.5$), and Valle d'Aosta ($\Delta_{20-21\%} = +199.2$ vs $\Delta_{19-20\%} = +86.2$).

Figure 2. Web interest of the Italian regions in the "byoblu" query year by year from 2016 to 2021. Y-axis = average relative search volume.

Risk perception

A part of the users seemed aware of the high number of fake news on COVID-19 circulating on the web and tried to limit its effects by relying on anti-hoax websites (Figure 3, next page). Nevertheless, the impact of COVID-19 was more incisive for conspiracy hypotheses ($t_1 = 11.3$ vs $t_2 = 4.5$, $\Delta_1 = +157.6$ vs $\Delta_2 = +84.7$), so much so that it is possible to observe a greater level-shift in the trend of infodemic web queries. This worsening was homogeneous on a national scale (Figure 4).

Figure 3. Comparison between the web interest in conspiracy hypotheses and anti-hoax services from 2016 to 2021. Y-axis = relative search volumes.

Figure 4. Heatmap of the relationship between web interest in conspiracy hypotheses and anti-hoax services: comparison 2016-2020 and 2020-2021. The index shows the percentage of infodemic queries (e.g. 70 means 70% conspiracy-related queries vs 30% anti-hoax-related queries).

With the announcement of the discovery of COVID-19 vaccines, web interest in side effects immediately soared ($t = 10.3$, $\Delta_{\%} = +905.2$ from October 2020 to April 2021). Although health authorities report rare side effects of adenoviral vector vaccines only, web interest in this topic has exceeded that in pollution and climate change ($SS_{vac} = 1.2$, $P_{MK} < .001$ vs $SS_{pol} = 0.81$, $P_{MK} < .001$, $\Delta_{\%} = +44.0$, Figure 4), which are much more urgent issues. Pollution and climate change effects-related query returned negligible RSVs.

Figure 5. Web interest in vaccines side effects and pollution/climate change from 2016 to 2021.

When considering vaccines names-related queries, the gap between the RSVs further widens ($SS_{vac} = 0.22$, $P_{MK} < .001$ vs $SS_{pol} = 0.05$, $P_{MK} < .001$, $\Delta_{\%} = +296.4$). As observable in Figure 6, the risk perception in vaccines has surpassed that in pollution and climate change in a homogeneous way throughout Italy (Figure 6, next page).

Figure 6. Comparison between the web interest in vaccines and pollution/climate change. The index shows the percentage of vaccine-related queries (e.g. 70 means 70% vaccine side effects queries vs 30% pollution/climate change-related queries).

Discussion

Principal Findings

To the best of the author's knowledge, this is the first study to investigate the impact of COVID-19 on pre-existing fake news and the risk perception of Italian web users. These findings show that the pandemic - understood as a set of different situations such as health crisis, economic crisis, lockdown, disease, infodemic - has significantly increased the phenomenon of conspiracy and interest in it. This influence caused not only a marked initial growth of relative search volume (RSV) during the first lockdown (March-May 2020) but also generated a pronounced level-shift in web interest that has persisted until nowadays. The regional web interest in the conspiracy hypotheses in the pre-COVID-19 2016-2020 period had assumed a clear negative trend and was more noticeable in some areas than in others. However, with the advent of the novel coronavirus, interest has increased to reach the highest value in the last five years, becoming even more homogeneous across regions. Due to the high dependence of the RSV on the day of gathering, it was not possible to search for correlations with the regional number of COVID-19 cases; nevertheless, the mean values and the variance of the sample have always remained similar. On the contrary, analyzing the data year by year, no change in the average interest in the infodemic YouTube channel "ByoBlu" (which had over 500,000 subscribers) was observed between the regions. Since a strong increase was highlighted nationwide, some regions must have contributed far more than others to the jump in total RSV. Specifically, as shown in Figure 2, Campania, Lazio, Friuli-Venezia Giulia, Trentino-Alto Adige, and Valle d'Aosta experienced a much higher increase than the other regions. Moreover, a growing trend in RSV during the last five years characterized all regions except Basilicata and Molise. Finally, web interest in fake news sources has increased more than that in anti-hoax services. These results are not to be underestimated: indeed, the Ministry of Health, various online platforms such as YouTube and Twitter, and social networks such as Facebook and Instagram have declared war without borders against the rampant infodemic. Specifically, under each video relating to the pandemic, YouTube has affixed a warning bar that offers users the opportunity to read the latest COVID-19 news on the Ministry of Health official website (complete with a button to access it). A similar procedure has been adopted by Facebook and Instagram (Figure 7, next page). All these companies have banned accounts and channels protagonists of the fake news spread, including ByoBlu [28-32]. This approach is partially consistent with the procedure proposed by the WHO to deal with the infodemic but was not sufficient to avoid a boost in disinformation in Italy. Among the problems that have undermined the effectiveness of these strategies, there is the resonance given by newspapers and television channels to unreliable or misleading information [33-36]. Beyond the mere disinformation contribution, this can foster distrust towards mass media, making the information campaign even more complex during times of crisis [37]. Furthermore, despite all the countermeasures adopted, social networks and messaging applications such as WhatsApp are a constant vehicle of fake news [33, 34, 37].

Figure 7. YouTube, Facebook, and Instagram COVID-19 informative bars (Italian language).

Alongside this, the influence of newspapers and television news on the risk perception on anti-COVID-19 vaccines was evident. Although the trend has been on the rise since early October 2020, the headlines of online, printed, and television news publications have often been the subject of criticism from the scientific community as sensationalistic and far from scientific evidence [38-40]. Distrust of vaccines is a growing problem that raises a serious question of public health [41-43]. Although most vaccines-related fake news circulates on social networks, the national mass media must attend to the evidence presented in the scientific literature with appropriate and thoughtful language. In particular, the effect of deliberately misleading titles linked to secondary aspects of the article can have serious consequences [44]. In such an intricate scenario, the web interest in vaccine side effects has overtaken that in pollution and climate change. Notwithstanding that the author of this paper loudly supports the pharmacovigilance process and is aware of the existence of numerous studies on the possible causal link between adenoviral vector COVID-19 vaccines and thrombotic events [45-47], it is necessary to consider that pollution and climate change constitute today one of the major global threats, claiming millions of victims every year [25, 48]. Since Janssen and Vaxzevria vaccines have very rare side effects [26, 48-51], it is reasonable to conclude that the risk perception of Italian users is distorted and disconnected from the real dangers that menace it. This is even more true when considering the incidence of COVID-19 itself in this type of event [52, 53].

Limitations

There are no guarantees that Google Trends is sufficient to investigate the totality of the interests of the Italian public. Furthermore, it is not certain that the keywords used in this research include all the terms related to the topics investigated.

Conclusions

COVID-19 has given a significant boost to online conspiracy attitudes in Italy. In particular, the average web interest in conspiracy hypotheses has increased and become more uniform across

regions. The pandemic accelerated an already growing trend in users' interest towards some fake news sources, including the 500,000 subscribers YouTube channel "ByoBlu" (canceled for disinformation in March 2021). The risk perception related to COVID-19 vaccines has been so distorted that vaccine side effects-related queries outweighed those relating to pollution and climate change, which are much more urgent issues. Based on these findings, it is necessary that the Italian authorities implement more effective infoveillance systems and communication by the mass media is less sensationalistic and more consistent with the available scientific evidence. In this context, Google Trends can be used to monitor the users' response to specific infodemiological countermeasures. Further research is needed to understand the psychological mechanisms that regulate risk perception.

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