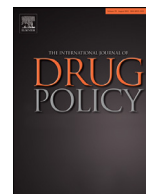




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Research Paper

Can google trends search inform us about the population response and public health impact of abrupt change in alcohol policy? A case study from India during the covid-19 pandemic



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ABSTRACT

Background: Sudden alcohol prohibition in India during the COVID-19 pandemic presented an opportunity to test whether Google Trends data could indicate population responses and the public health impact of alcohol policy. We hypothesized, following prohibition: there would be a significant change in the relative search volumes (RSV) of alcohol-related queries; that temporal analysis of the trends would reflect a public response to policy changes; and that geospatial analysis of RSV would correlate with the prevalence of alcohol use.

Methods: Three different search periods were used to test the hypotheses. The search inputs were based on potential public response to alcohol prohibition, as evidenced by the literature, newspaper articles, and consensus. We used RSV as the unit of analysis. Mean RSV of search queries, pre-post implementation of prohibition, were compared. Smoothing of scatter plots examined the temporal association of trends with policy measures. Multiple linear regression tested the relationship of state-wise RSV and alcohol use prevalence.

Results: Post-implementation of prohibition, a significant increase in the RSV was observed for searches related to alcohol withdrawal ($p < 0.001$), how to extract alcohol from sanitizer ($p = 0.002$), alcohol home delivery online ($p < 0.001$), alcohol home delivery ($p < 0.001$), and sleeping pills ($p = 0.006$). The trends suggested a decrease in general interest in alcohol but increased demand, and a possible connection with changes in policy measures. State-level RSV and alcohol use prevalence did not reveal a significant relationship.

Conclusion: Google trend is a potential source of rapid feedback to policymakers about population responses to an abrupt change in alcohol policies.

Introduction

Google Trends is an open-source online portal of Google Inc. It provides data with temporal and geospatial patterns of relative search volumes of user-specified search terms. Institute of Medicine has recognized a complementary role of internet search 'Big Data' and considers it as an extension of the existing data foundations (Brownstein, Freifeld & Madoff, 2009). India has an ever-growing number of internet users, which is second in the world. The latest report by the Internet & Mobile Association of India estimated 503 million internet users (more than 30% of India's population), distributed evenly between the urban and rural areas (Mishra & Chandani, 2020). More than 98% of internet users use Google

as their search engine. Google Trends search has been predominantly used for surveillance of infectious disease epidemics. Although the use of Trends data for mental health and substance use disorders has been on the rise, suicidal behavior and the emergence of new psychoactive substances have dominated the research domains so far (Bright, Bishop, Kane, Marsh & Barratt, 2013; Gallagher et al., 2012; Mukherjee et al., 2020; Nuti et al., 2014; Yang, Tsai, Huang & Peng, 2011).

The Global Status Report on Alcohol and Health (2018) revealed that India had a per capita alcohol consumption of 5.7 L and an increasing trend observed in the last decade; moreover, the trend was highest among the other South-East Asian Region (SEAR) countries. More than 90% of the consumption consisted of distilled spirits. A growing trend was also seen in the proportion of people with heavy episodic

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drinking (WHO, 2018). Both the amount and pattern would lead to adverse public health impacts. As per the International Wines and Spirits Record (IWSR) Drinks Market Analysis, India is the ninth-largest consumer of alcohol and the second-largest consumer of spirits in the world (IWSR Drinks Market Analysis). A recent national survey revealed 5.2% of India's population, an estimated 57 million people were either harmful or dependent alcohol users; however, the magnitude varied widely across the states (Ambekar et al., 2019).

Following overnight notice, on March 25, 2020, India declared a nationwide lockdown to contain the spread of SARS-CoV-2. The Epidemic Diseases Act (1897) was implemented, and offices, transport, and all non-essential services were shut down. Only emergency medical care and the sale of essential food and beverages were permitted. There was a complete prohibition on manufacturing, transport, sale, and purchase of alcohol, implemented on the same day. There is no national-level alcohol policy in India. Consequently, several states took disparate measures by making provisions for alcohol supply to nullify the prohibition. Some states (e.g., Kerala, West Bengal, Assam, Meghalaya) tweaked the prohibition policy imposed by the Government of India by allowing "home delivery of alcohol," "online alcohol sale," "alcohol sale for limited hours of the day," "alcohol prescription by a registered medical practitioner." These measures could be implemented only for a few days and were thwarted either by the Government of India or by the legal mandate. Some other states (e.g., Punjab, Maharashtra, Karnataka, Odisha) proposed to implement some of these measures and requested approval from the government of India but finally the changes did not ensue. (FPJ Webdesk 2020b, 2020, 2020c; Government of Kerala. Kerala Excise Department, 2020). Therefore, the alcohol policy witnessed either a short-lasting change in some states or contemplation of change in other states. In sum, a de facto prohibition lasted from March 25 to May 3, 2020 (Lockdown phase 1 and 2). Following May 3 (Lockdown phase 3), mounting pressure from the state governments forced the center to pay heed to their demands, and the prohibition was gradually lifted.

Given the growing number of internet users and significant magnitude of alcohol use, sudden alcohol prohibition presented an unprecedented opportunity to perform a "case study" as to whether Google Trends data could indicate the population responses and public health-related ramifications of abrupt changes in alcohol policy.

Google Trends generally represent the level of online interest for particular search inputs. The prevailing literature on Google Trends reveals that Google searches could also be a "proxy indicator" of behavior at the population level. Studies from the UK and the USA have consistently reported the association between suicide-related Google searches and suicide rates among the general population (Barros et al., 2019; Kristoufek, Moat & Preis, 2016; Mc Carthy, 2010). Studies on influenza-like illness and gastroenteritis showed a strong correlation between specific online queries related to these illnesses and percentages of physician visits or emerging epidemics (Ginsberg et al., 2009; Pelat, Turbelin, Bar-Hen, Flahault & Valleron, 2009; Zimmer, Leuba, Yaesoubi & Cohen, 2018). The assessment of popularity and harms caused by novel psychoactive substances with Google Trends data is another example showing that Google Trends is a sensitive tool for understanding a "novel" and emergent phenomenon.

The sudden and unprecedented prohibition of alcohol could result in changes in population behavior. A media analysis suggested different types of population responses and possible public health impact following COVID-19 related alcohol prohibition in India (Ghosh et al., 2020). We expected Google Trends to detect the behavioural response at the population level to the "novel" and "emergent" alcohol ban in India imposed on March 25, 2020.

We started with the following hypothesis: (a) following the prohibition, a significant change would be observed in the online interest of user-specified search terms related to alcohol; the change in the online search interest was a "proxy marker" of population behavior, which in turn could indicate the public health impact of the alcohol policy (b)

temporal analysis of Google Trends (for specific search queries) would reflect the public response to the policy changes; the temporal association would suggest a possible connection between the particular policy measure and fluctuations of online interest (or population behavior) (c) The third hypothesis was based on the assumption that there would be a higher demand for alcohol during prohibition in states with a higher prevalence of alcohol use, and the alcohol-related search could be proportional to the increased demand. Therefore, the geospatial analysis of the search trend would correlate with the state-level prevalence of alcohol use.

Methods

Google trends

Google Trends provides a relative search volume (RSV), which is the query share of a user-specified term, normalized by the highest query share of that term over the time-series, for a specific location and period (Choi & Varian, 2012). It is a two-staged process. The first stage estimates the relative popularity, i.e., the ratio of a query's search volume to the sum of the search volumes of all possible queries of the geography and time range. In the second stage, the resulting numbers are scaled on a range of 0 to 100 based on a topic's proportion to all searches. The first stage ensures the popularity of the search term should be independent of internet traffic. Moreover, "Trends" eliminates repeated searches by the same person over a short period of time, and it shows only data for popular terms. These would (a) prevent spurious inflation of search volume by a single user; (b) ensure the user-specified search terms are popular enough to generate a time-series trend.

In our paper, we used RSV as the unit of analysis. We added up the daily RSV to generate the RSV mean and standard deviation for the various periods under study.

Search procedure

Search filters

We performed the search on the "Google Trends website." The following filters were used: location ("India"), categories ("all categories," which includes twenty-seven search categories), type of search ("web search"). We customized the time range as per the study requirement.

Search periods

March 10 to April 9, 2020: The lockdown and prohibition on alcohol were enforced on March 25. Therefore, March 10 to April 9 took into account the search trends two weeks before and two weeks following the prohibition. We examined the changes in the mean RSV of user-specified search inputs before and after March 25 (i.e., the day of implementing alcohol prohibition). This was done to test our first hypothesis, i.e., there would be a significant change of online interest of alcohol-related terms following the ban. The search was carried out on May 12.

March 10 to May 23, 2020: This time period included trend searches pre-prohibition (March 10 to March 24), during complete prohibition (March 25 to May 3), and the phasic withdrawal of prohibition (May 4 to May 23). The more comprehensive time range was chosen to capture the "trends" of the search inputs and their fluctuations with the alcohol policy changes made over time. We could test our second hypothesis of visualizing population response to changing policy measures.

The same search period was also used for conducting the "control" search inputs.

The search was conducted on May 25.

March 25 to May 3: This time range captured the period of complete alcohol prohibition. We performed the geospatial search by accessing the sub-region RSV (i.e., state-wise RSV for India) for this time period. The third hypothesis of a positive relationship between state-wise RSV of specific search inputs and state-wise prevalence alcohol use was tested using this time range.

Search inputs

The search inputs were based on (a) brainstorming of investigators-AG, AB, FR, SC. The first two have been working in the field of addiction psychiatry for more than six years, and the latter two are addiction psychiatry trainees, (b) literature on the public health impact of alcohol prohibition, and (c) newspaper reports published during the period of this study. The inputs were finalised after consensus among the authors (AG, FR, SC, AB). We carried out a Trends analysis of 3 related terms- 'alcohol,' 'wine,' and 'liquor.' The normalised graph (Supplementary figure 1) showed largely overlapping trends. We decided to uniformly use 'alcohol' for all our search inputs. The final search inputs were: "alcohol"; "alcohol sale"; "alcohol availability"; "alcohol home delivery"; "how to make alcohol at home"; "alcohol withdrawal"; "sleeping pills"; "how to extract alcohol from sanitizer"; "alcohol substitute"; "alcohol in black"; "alcohol treatment"; and "de addiction center." As we entered our pre-specified search items, Google Trends provided options for other related search terms. We opted for the one with a higher relative search volume. For example, we entered the pre-specified term- "alcohol in black market." However, in the related terms, we found a significantly higher RSV for "alcohol in black." Hence, the final Google Trend was generated with the search term- "alcohol in black." We did not use plus sign (+), minus signs (-), or quotations marks for search terms.

The search terms purported to discover searches related to alcohol dependence were: "alcohol withdrawal," "sleeping pills," "how to extract alcohol from sanitizers" (suggestive of compulsion of use or craving; use despite the knowledge of harmful consequences), "alcohol substitute," "alcohol in black," "alcohol treatment" and "deaddiction centers." Other search terms were more generic and applicable to both dependent and nondependent uses of alcohol.

We did two "control" Trends searches. One search query was "coronavirus." As it is a "novel" virus and has produced a significant public health concern, it was expected to stimulate public interest. Should Google Trends be able to detect the online interest and generate the desired trajectory, its performance as a proxy of population interest and behavior could be confirmed in the Indian context. For another search input ("alcohol"), we ran a duplicate search for the same period (March 10 to May 25) last year (2019). This was to rule out any specific pattern in the online interest during this time of the year.

All data were downloaded as .csv files.

Other data source

The state-wise prevalence of alcohol use was accessed from the published report by the Ministry of Social Justice & Empowerment (Ambekar et al., 2019). State-level data of internet users were available for the year 2018, from the report by Telecom Regulatory Authority of India ((The Indian Telecom Services Performance Indicators July – September 2018 2020). However, this report combined data for some states (e.g., Madhya Pradesh and Chattisgarh). We estimated the number of internet users of the individual states from the population ratio.

Adherence to reporting guidelines

We adhered to the Nuti and colleagues guidelines for documentation of Google Trends (Nuti et al., 2014). The checklist has been incorporated as supplementary Table 2. The interpretation of the trends data was based on independent observations and consensus to minimize the potential subjective bias.

Statistical analysis

The relative search volumes (RSV) 2-weeks before and after the implementation of alcohol prohibition were tested by an independent sample *t*-test, with the assumption of unequal variance. Any significant changes were detected by a *p*-value of <0.05 (two-tailed). The

Google Trends curves were smoothed by the Locally Weighted Scatterplot Smoothing (LOWESS), done by the python program. The degree of smoothing or the span value was kept at 0.25. A lower span value was likely to minimize the sum of square error and had actually produced optimal curves on visual inspection. We ran a linear regression model with RSV from each state as the dependent variable, and prevalence of alcohol use and the number of internet users as independent variables. The standardized coefficients, *t*-values, and two-tailed significance were calculated.

Results

Comparison of relative search volume (RSV) before and after implementation of prohibition

RSV of all the pre-specified search inputs was compared with unpaired *t*-test. Post-implementation of prohibition, a significant increase in the RSV was observed in alcohol withdrawal ($p < 0.001$), how to extract alcohol from sanitizer ($p = 0.002$), alcohol home delivery online ($p < 0.001$), alcohol home delivery ($p < 0.001$), and sleeping pills ($p = 0.006$). However, following the declaration of alcohol prohibition, a significant decrease was seen in the RSV of the search input: alcohol ($p < 0.001$). No significant changes were observed in: alcohol sale ($p = 0.34$), alcohol availability ($p = 0.91$), alcohol in black ($p = 0.70$), homemade alcohol ($p = 0.67$), and alcohol treatment ($p = 0.65$). The comparison could not be made for the search input, "alcohol alternate" because of too few data points. Please see Table 1 for further details.

Visual inspection and interpretation of the 'control' curves

A "control" curve with the search input "Coronavirus" was generated to tap people's general interest and as a 'proxy' of population behavior in response to the novel viral pandemic. The RSV showed a sharp peak in the 3rd week of March when the cases in India were rapidly escalating. Gradually over a period, the rise plateaued before touching the baseline. The observed trend was in line with the expectation: any novel phenomenon would initially garner a lot of interest, which would gradually reduce (Supplementary figure 2). This control curve would suggest Google Trends is sensitive to public interests, concerns, or intentions in the Indian population. The second "control" curve was the trend for 'alcohol' from March 10 to May 23, 2019. The trend did not show any peak or trough during this period. This would suggest seasonal or "yearly" Trends of the alcohol-related search were unlikely. Besides, no extra-ordinary alcohol policy-related measures were undertaken during this time in 2019; therefore, significant changes in "alcohol" trends

Table 1

Comparison of Relative Search Volume (RSV) of search inputs pre and post alcohol prohibition.

Search inputs	RSV (March 10 to March 24) Mean (SD)	RSV (March 26 to April 9)	t-value	p-value
Alcohol	70 (14.84)	46.37 (13.76)	4.52	0.000008
Alcohol sale	35.4 (29.73)	46.06 (31.56)	0.95	0.31
Alcohol withdrawal	32.4 (16.02)	67 (21.70)	4.97	0.000023
Alcohol availability	30.46 (33.76)	31.87 (38.10)	0.11	0.91
Alcohol home delivery	8.87 (6.55)	41.13 (25.42)	4.75	0.00013
Alcohol home delivery online	4.27 (11.26)	41.25 (25.09)	5.21	0.00002
how to extract alcohol from sanitizer	0 (0)	22.94 (24.84)	3.58	0.0021
Alcohol treatment	42.33 (12.20)	45.12 (20.97)	0.44	0.65
Sleeping pills	54.67 (12.35)	69.37 (15.49)	2.87	0.0066
Alcohol substitute	52.4 (17.53)	30.27 (31.93)	2.35	0.03
Homemade alcohol	45.2 (27.82)	40.87 (28.39)	0.42	0.67
Alcohol in black	53.53 (28.91)	49.2 (31.50)	0.39	0.70

were not observed (Supplementary figure 3). In other words, fluctuations of search trends observed in this year's data could be considered as a function of the alcohol prohibition and other policy changes.

The temporal relationship between alcohol policy measures & google trends of pre-specified search inputs

We did a thorough visual inspection of the LOWESS modified Google Trends curves to examine the correlation between the changing alcohol policy (or contemplating a change in policy) and public health response. After independent examination of the Trends and interpretation of putative relationships, a meeting was held among four authors (AB, AG, FR, SC), all independent view-points were discussed, and a consensus was reached.

Increased demand for alcohol persisted throughout the period of prohibition, as evidenced by the trends of 'alcohol availability,' 'alcohol home delivery,' and 'alcohol home delivery online.' The rise in the trend of 'alcohol withdrawal' following the commencement of the prohibition was a tell-tale sign. This trend coincided with the trend for 'sleeping pills,' suggesting people's need for treatment. The 'alcohol treatment' graph did not show any definite peak. The Google Trends for 'extraction of alcohol from sanitizer' reflected the desperation of people to alleviate sufferings, persistent demand, and a lack of definite policy of fulfilling the treatment needs. The relatively later onset of the peak supported the assumption of desperation. However, the trend of 'alcohol' reflected a reduction in general interest during this time. The details of search inputs, peaks of interest level, an impression about the relationship between changing Trends and alcohol policy have been discussed in [Table-2](#). [Figs. 1, 2, and 3](#) depict the online interest related to the search inputs, "alcohol withdrawal & sleeping pills," "alcohol home delivery," "extraction of alcohol from sanitizer." Other Trends curves have been added as supplementary figures (4 and 5).

Correlation of state-wise prevalence of alcohol use & rsv for search inputs

The linear regression analyses showed no significant relationship between the state-wise prevalence of alcohol use and geospatial RSV for any of the search inputs. Too few data points precluded analyses of alcohol home delivery online and alcohol availability. The details are included in supplementary Table 1.

Discussion

Our analysis showed that Google Trends could detect a statistically significant change (of user-specified, relevant search inputs) following a robust change in alcohol policy. Temporal analysis by visual inspection of normalized Trends graphs primarily reflected the population response and public health impact of the policy measures. The inclusive search terms might have been a proxy for population-level behavior of both dependent and nondependent alcohol users. Some of the search inputs (e.g., "how to extract alcohol from sanitizer," "how to make alcohol at home," "alcohol home delivery") were intended to discover the motive of the search. This strategy was borrowed from Ayers and colleagues (2016). Google Trends generates the relative popularity of a search term, followed by relative search volume; hence, possible higher internet traffic during the lockdown would not have impacted the results. However, the state-wise search volumes did not show a significant correlation with the prevalence of alcohol use. Altogether, our study demonstrated the credibility of Google Trends data to inform the policymakers about the direction (but possibly not the magnitude) of the public response to changing alcohol policy. The credibility of the data can be evidenced by its accordance with (a) existing clinical knowledge and concurrent evidence: the rise and fall of 'alcohol withdrawal' nearly corresponded with the clinical course (Kosten and O'Connor, 2003); a significant increase in the number of hospital admissions was also reported, in line with the Trends data for 'alcohol withdrawal' (Narasimha et al., 2020);

(b) literature on alcohol (Hall, 2010); (c) newspaper reports: the first peak of 'extraction of alcohol from sanitizers' and the second and third peaks of 'online alcohol delivery' corresponded with reports of deaths and morbidity after drinking sanitizers and online scams, respectively (Narayanan, 2020; Nath, 2020).

Although a significant increase in the trends of "alcohol home delivery" and "alcohol online delivery" would suggest persistently increased demand for alcohol despite prohibition, the absence of significant changes in search volumes for "alcohol sale," "alcohol availability," and "alcohol in black," appeared to be counterintuitive. We propose the following explanation for this: (a) during the period of the study, COVID-19 cases were rapidly increasing in India, from 618 patients on March 25 to 125,000 cases on May 23. People might have been fearful of venturing out to buy alcohol and explored the "novel" option of home or online alcohol delivery; (b) To contain the rapid spread of infection, the government of India classified districts into graded risk-zones. Out of 718 districts in the country, 414 (57%) fell into the moderate to a high-risk category in May 2020 (Livemint, 2020). The state governments created many containment zones within the high-risk zones to prevent the spread of COVID-19. For example, in the second week of May, there were 338 containment zones in Kolkata, the capital city of West Bengal. In the containment zones, movement was highly restricted, and people could come out only for valid emergency needs. Under this strict vigil, perhaps people avoided going out to purchase alcohol and wanted alternative measures to procure it; (c) searching on the sale of alcohol in the black market has a negative and criminal connotation. Such information is unlikely to be available on the open network.

The non-significant linear regression of the relationship between the state-level prevalence of alcohol use and RSV for online queries could have resulted from the influence of unmeasured (or unavailable) third variables. One such example is the rate of English literacy across the states: we analysed searches made only in English. The general adult literacy rates vary widely across the Indian states, from 93 percent in Kerala to 64 percent in Bihar. However, we do not have any reliable estimates for English literacy. Besides, twenty-two languages are scheduled by the Indian Constitution, and there is no national language. Therefore, conducting an online search in any particular regional language was not worthwhile. This was in contrast to Google Trends research done in other non-English speaking Asian countries such as Japan and Taiwan, where researchers used search inputs in respective national languages (Yang et al., 2011; Sueki, 2011). Another limitation that may account for the non-significant result is that the data for the prevalence of alcohol use, internet usage, and relative search volumes of online queries were obtained at different time points, in 2019, 2018, and 2020, respectively. The discordant data points might have also contributed to the non-significant results owing to a possible change in the first two parameters during the last 1–2 years. Finally, the estimated prevalence of alcohol use disorders could have been a better marker of "alcohol demand." However, the state-level data of only the top ten Indian states regarding the prevalence of alcohol use disorders are available in the public domain Ambekar et al., (2019). In sum, the non-significant regression informed us about two important points regarding the Google Trend-based research: (a) Google Trends would perform best in either English speaking countries or in countries with a uniform national language, (b) more robust results would require availability, access, and periodic update of the key comparison variables, such as prevalence of alcohol use.

Our study should be read in light of the following limitations: (a) this was an observational study. Therefore, no definite causal inference should be drawn between changing alcohol policy and the public health response; (b) the search inputs were limited to English. The 2011 census estimated that a little more than 12 to 30 percent of the Indian population could read, write, and speak English. Although it is the second most common language spoken in the country, we acknowledge this as a serious limitation of our study (Census, 2011). (c) illegal and criminal

Table 2
The relationship of alcohol policy measures and public response.

Search inputs	Peaks of "online interest" level	Alcohol policy measures taken (contemplated) during the time	Interpretation
Alcohol	Largely a flat curve from March 30 to May 3, i.e. during lockdown 1.0 & 2.0 The two peaks were before the lockdown 1.0 and during lockdown 3.0	During lockdown 1.0 & 2.0: complete alcohol prohibition (centrally enforced) During lockdown 3.0: prohibition was gradually lifted in several states	A significant reduction in the general interest in alcohol during the period of prohibition
Alcohol sale	Flat curve till the beginning of lockdown 3.0 The graph rose during lockdown 3.0	There were no additional restrictions on alcohol sale before lockdown 1.0 There was a complete prohibition during lockdown 1.0 and 2.0 There was uncertainty about the alcohol sale and mode of sale during lockdown 3.0	Uncertainty forced people to search for potential sources of "alcohol sale" Demand for alcohol continued after prohibition
Alcohol withdrawal	Peak between March 29 to 4 th April	Prohibition on alcohol during this period	People with possible alcohol use disorders suffered from (or anticipated) withdrawal symptoms Personal stock might explain a relatively later onset and lasting peak
Alcohol availability	The larger peak started around April 5 and touched baseline around 6–7th May	Centrally enforced prohibition Several states (e.g. Kerala, Chattisgarh) permitted alcohol "on prescription" or opened outlets for limited duration; decisions revoked in 3–4 days	Increased demand for alcohol continued during the period of prohibition The later peak might be contributed by the expectation generated from state alcohol policies
Alcohol home delivery	Two small peaks in the first two weeks of lockdown	Several states started or contemplated home delivery of alcohol (e.g. Kerala, West Bengal, Punjab) during the two initial peaks	Demand for alcohol continued unabated during the lockdown
&Alcohol home delivery online	A large peak during lockdown 3.0	States started home delivery (e.g. Odisha, Chhattisgarh, West Bengal, Kerala) during lockdown 3.0	Public expectation of home delivery (or online delivery) The occurrence of online scams reported in the newspaper coincided with the second peak Largest peak represented increased demand after the prohibition was lifted
Alcohol from sanitizer	Two peaks: first one began after the lockdown 1.0 and second one started with the lockdown 2.0 Ended during lockdown 3.0	Total prohibition during lockdown 1.0 and 2.0 Gradual opening up of retail and online sale during lockdown 3.0	Increased demand for alcohol The desperation of people (possibly with use disorders) to control withdrawal and craving. Several newspaper reports of death and morbidity due to hand sanitizer consumption was also reported during the end of lockdown 1.0
Alcohol in black	No peak as such A slight rise of the RSV following lockdown 1.0, which stabilized within a week A relatively high RSV continued throughout the period of lockdown 1.0 and 2.0	Effective policing reported in the media	The prohibition was for a short span of time Effective implementation through policing might have been possible
Alcohol treatment	No peaks	A large majority of the drug and alcohol treatment centres were closed All public conveyance were stalled	Treatment needs persisted during the prohibition but no specific policy was formulated to address the need
Sleeping pills	No peaks but RSV increased following the lockdown 1.0	Prohibition of alcohol Imposed home isolation	Increased demand for sleeping pills Possible reasons: alcohol withdrawal To alleviate fear and anxiety-related to COVID-19 To self-treat insomnia
Sleeping pills & Alcohol withdrawal combined	The 'alcohol withdrawal' peak coincided with the first peak of 'sleeping pills'	Alcohol prohibition No policy to address the treatment need	Reflected public response of searching for treatment to alleviate withdrawal

activities (such as black marketeering of alcohol) might be less visible on the open net.

In sum, our study had significant implications for alcohol and drug policy research and practice. Firstly, we showed a rapid, robust, and consistent change in the Google Trends search with the changing alcohol policy. Few data sources can assist policymakers in reflecting on policy change, and Google Trends is one such potential source of rather rapid feedback about responses to policies. However, we recognize this case study was an extreme example of abrupt alcohol prohibition, which might have exaggerated the Trends data. Whether and how incremental alcohol policy measures (e.g., higher pricing, taxation, restricted availability, restrictions in advertising) affect Google Trends remains to be

seen. We believe a relatively longer duration of observation might be needed to examine the credibility of the Trend data under these circumstances. Secondly, Google Trends data could also be tested in the future for other licit substances, such as tobacco and cannabis (in states and countries where recreational or medicinal use is legal). One might examine the effect of legalization of recreational use of cannabis by (a) comparing the online interest of cannabis-related terms before and after legalization, and comparing the geospatial differences (states in which it is legalized vis a vis where cannabis is illegal) of online interests; (b) examining the relative search volumes of terms describing symptoms of intoxication for early detection of harmful effects. The latter example was aligned with the evidence of early and reliable detection of infectious

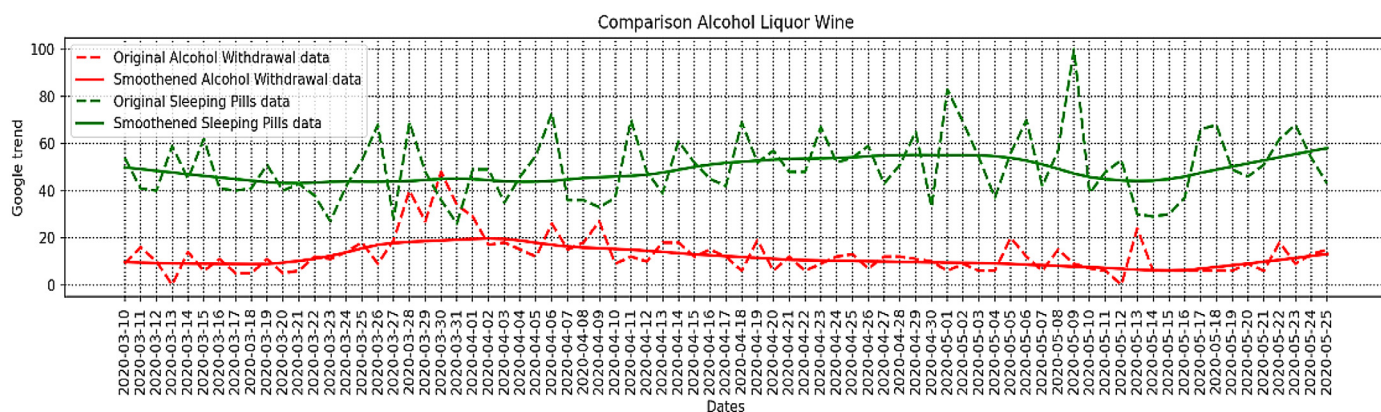


Fig. 1. Relative search volumes (RSV) of "alcohol withdrawal" and "sleeping pills" on a scale of 0 to 100. Thick, unbroken lines show trends using Locally Weighted Scatterplot Smoothing (LOWESS). Thin broken lines are daily RSV from March 10 to May 23 2020. The red and green represent Trends for alcohol withdrawal and sleeping pills, respectively [Data Source: Google Trends].

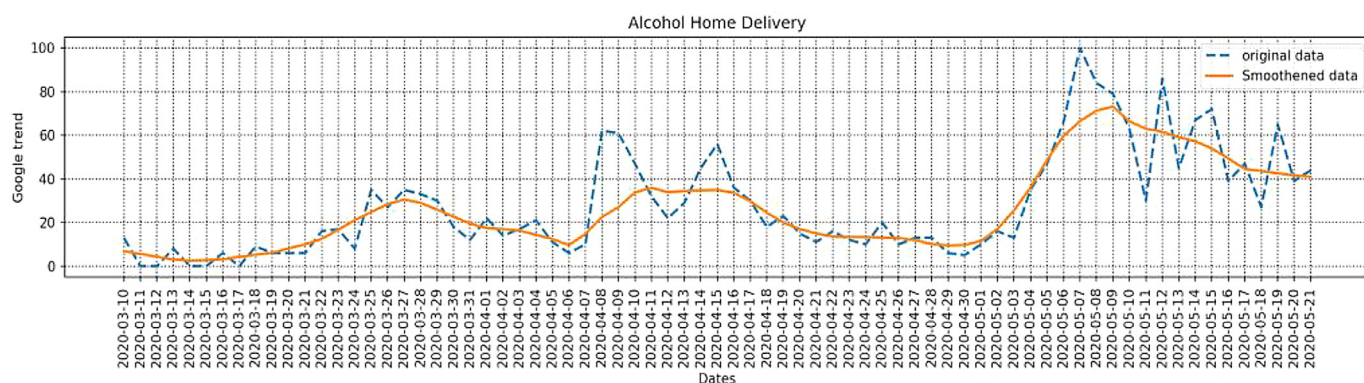


Fig. 2. Relative search volumes (RSV) of "alcohol home delivery" on a scale of 0 to 100. Thick, unbroken lines show trends using Locally Weighted Scatterplot Smoothing (LOWESS). Thin broken lines are daily RSV from March 10 to May 23 2020. [Data Source: Google Trends].

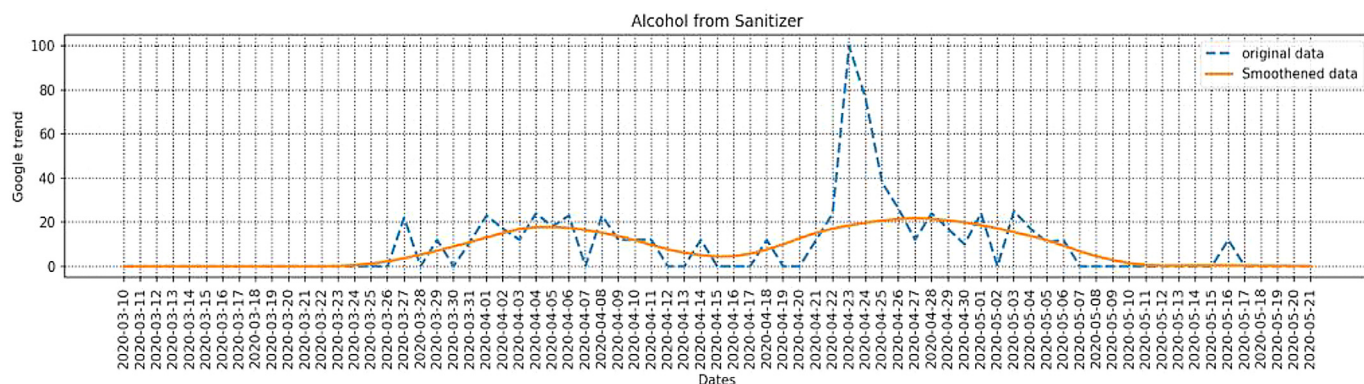


Fig. 3. Relative search volumes (RSV) of "extraction of alcohol from sanitizer" on a scale of 0 to 100. Thick, unbroken lines show trends using Locally Weighted Scatterplot Smoothing (LOWESS). Thin broken lines are daily RSV from March 10 to May 23. [Data Source: Google Trends].

disease epidemics with Trend data (Chan, Sahai, Conrad & Brownstein, 2011; Ginsberg et al., 2009). Thirdly, Google Trend data could capture the public response, even in a non-English speaking country. Finally, we explored and validated the credibility of this inexpensive, accessible Big Data source, which has yet to be tapped to modulate alcohol or drug policy.

Declaration of Interests

None.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.drugpo.2020.102984.

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