Using Google trends data to study public interest in radiation

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Abstract. This study evaluates the correlation and cycle of public interest in radiation worldwide with radiation-related incidents between countries using Google Trends from 2008 to 2018. Google trends was employed to normalise traffic data on a scale of 0 to 100, and were presented as monthly relative search volume (RSV) using radiation, radioactive, nuclear medicine and x-ray as a search term. A remarkable peak was identified in March 2011 during the Fukushima Daiichi nuclear disaster. In conclusion, public interest towards radiation is correlated with radiation-related incidents or events.

1. Introduction

Radiation is the emission and transference of energy through any medium in the form of electromagnetic waves or particles, which are categorised into ionising and non-ionising radiation [1]. X-rays from medical radiography examinations are a common source of ionising radiation, which is recognised by the public. High doses of ionising radiation produce deleterious consequences in humans, including, but not exclusively, cancer induction. At low radiation doses, the situation is less clear. However, the risks of low-dose radiation are of societal importance in relation to various issues, such as screening tests for cancer, nuclear power, occupational radiation exposure and frequent-flyer risks [2]. When natural radioactivity was first discovered, radiation was thought to produce a solely detrimental effect on organisms. Such was the typical perception of people towards radiation. The public should be aware that currently, radiation is used in medicine, academics and industry, as well as for generating electricity to benefit humankind.

Despite the role that radiation plays in our daily lives, the public’s knowledge and attention toward radiation are relatively low. A previous study [3] found that awareness of health risks associated with ionising radiation is lacking. This finding is in general agreement with the results of other similar studies across health professions, such as senior medical students [4], emergency department (ED) doctors [5], doctors [6], radiology residents, fellows, staff radiologists and technologists [7]. This lack of knowledge indicates that healthcare professionals are unable to protect themselves or their patients effectively from ionising radiation.

With the advancement of web technology and its growth, a huge volume of data is available over the web for Internet users, where users can easily retrieve various information. Social networking sites, such as Twitter and Google, have used expansively because they enable people to search, share and express their views on topics across the world. Recent issues easily attract public interest through the rapid spread of information in a network. This increasing number of searches or queries generates ‘big data’, which provide meaningful research in infodemiology. The information-seeking behaviour can be measured by the frequency with which the public enters specified search terms. It has been...
utilised successfully to show the public’s interest cycles, which suggests that infoveillance can measure the success of a campaign in driving information-seeking behaviours [8]. This web data surveillance potentially leads to increase of knowledge on campaign strategies centred on timing of interest cycles.

Google Trends (GT) is a public web facility of Google, Inc. that shows the frequency of a particular search-term entered relative to the total search-volume across various regions of the world. It operates by analysing a portion of Google searches to compute the amount of searches that occurred for the terms entered relative to the total number of searches that occurred on Google over the same time. The data retrieved will be presented as relative search volume (RSV) and the results are displayed in a graph. This study investigated and compared public interest on radiation between countries from 2008 to 2018. The relationship between public interest in radiation from GT and radiation-related incidents is determined. We hypothesised that public interest in radiation is correlated with radiation-related incidents or events. To our knowledge, this study is the first to determine the public’s perception of radiation on a global scale based on GT. Hence, it could provide us with valuable insights that may be used for future work with other social online platforms.

2. Materials and Method

2.1. Google Trends

Data from GT were mined and saved in a comma-separated values (CSV) file, which stores tabular data (numbers and text) in plain text. Numerical data is presented as RSV, which is computed as the percentage of queries on a particular term for a given location and time period. The RSV values indicate the ratio of the search volume of specific Google’s queries to the search volume of overall Google’s queries performed in specific regions and time intervals. GT has normalised data using the highest query share of that term over the time series and presented on a scale of 0 to 100. Each data point is divided by the total searches of the geography and time range it represents to compare relative popularity. Otherwise, places with the most search volume would be ranked highest. Technology evolves and the number of people searching on Google changes with the development of technology, that is, the search volume in earlier years was much smaller than that currently. Hence, raw search numbers were unsuitable for comparing searches then and now. GT incorporated normalisation of data, namely, comparison across dates and countries or cities, which allows research into deeper insights. In this study, GT was used to explore Internet activity related to radiation in the study on public interest cycle towards the same. The study period spans 1 February 2008 to 1 February 2018. We used ‘Radiation’ as the search term. A time range of 10 years was selected because a radiation-related incident (Fukushima nuclear disaster) occurred in 2011, in which data before, after and during that year are deemed significant.

2.2. Data Analysis

Results are collected with tabulated RSV data. We descriptively analysed the changes in web search queries about radiation at the global level for 2008 to 2018 and evaluated the correlation between radiation-related incidents supported with news articles. We also analysed top and rising queries related to the search term and assessed interest at the global level and regional interest at the country level toward radiation on the web. A map of geographical queries worldwide for each search term is plotted for clear visualisation of data.

3. Result

We report monthly data for web searches related to radiation retrieved from Google Search. From February 2008 to February 2011, RSV data from web search queries on radiation fluctuate at approximately 20 with peak of interactions between 15 March and 18 March 2011 (Figure 1). Few other slight surges in the search queries have been registered in April 2008, March and April 2010,
October and November 2013, January 2014, November 2015 and February and March, 2017. In March, 2011, the GT-RSV increased markedly, which reached 100 in comparison to a mean value of 20.3 that was detected previously.

Figure 1. Multi-timeline showing RSV comparison of search term “Radiation” Google search tool.

3.1. Related Queries
The top searches are terms that are frequently searched with the selected search terms in the same search session, whereas rising searches are terms searched with the selected search terms which had significant growth in volume in the requested time period. For each rising search term, the data show the percentage of the term’s growth compared to the previous time period. A ‘breakout’ in growth percentage denotes the search term grew by over 5,000%. Table 1 shows the top and rising queries for search terms that yielded results along their respective RSVs. The majority of queries focused on radiation with regard to the definition of radiation and its effect on humans as well as therapeutic uses. Meanwhile, the majority of the rising queries were dedicated to the Fukushima radiation leakage incident.

Table 1. Top five related queries and rising queries for each search term.

| Search Terms       | Top 5 Queries          | RSV  | Rising 5 Queries          | Growth Percentage |
|--------------------|------------------------|------|---------------------------|-------------------|
| Radiation          | what is radiation      | 100  | fukushima                 | >5000%            |
|                    | radiation therapy      | 89   | fukushima radiation       | >5000%            |
|                    | cancer radiation       | 87   | fallout 4 radiation       | >5000%            |
|                    | radiation effects      | 58   | radiation pole emploi     | >5000%            |
| electromagnetic    | radiation              | 47   | fukushima radiation map   | >5000%            |
| radiation          |                        |      |                           |                   |

3.2. Geographical Queries
Table 2 shows the countries that have the highest search. Singapore is the country with most search queries about radiation followed by Philippines and the United States.
4. Discussion
This study is the first to analyse public interest on radiation using GT activities globally from 2008 to 2018. Radiation has attracted global public interest, which generated millions of related Internet searches worldwide. In marketing sciences, a well-known truism is grounded on studies on GT’s power [9] In other words, search volume is correlated to contemporaneous events. The same rationale is employed in several health research fields and has been useful in elucidating a wide range of questions from vaccination compliance [10] to interest in cancer issues after prevention campaigns [11].

Previous studies that assess the levels of public knowledge on cancer risk factors and review awareness of the link between alcohol consumption with cancer show public interest or awareness towards certain issues highly influenced their lifestyle [12,13]. This notion is consistent with the aims of this study because we intend to utilise the results for future development in health campaigns to raise public awareness towards radiation and reduce the occurrence of radiation-related incidents. Results highlight two points: (1) the peak of public interest towards radiation during Fukushima Daiichi nuclear disaster and (2) countries with high levels of public interest towards all search terms.

Majority of the peak of the search volume on ‘radiation’ may due to other radiation incidents. The ‘radiation’ search term registered a significant peak in March, 2011 particularly 15 to 18 March 2011. This peak is due to the Fukushima Daiichi nuclear disaster, which occurred on 11 March 2011 with a magnitude 9.0 earthquake. The other peaks of this radiation query are related mostly to the disaster. The peaks in October and November 2013, in which the latter may have been due to the news of radiation levels around tanks that store contaminated water in Japan’s crippled Fukushima nuclear plant, have risen from a fifth to a new high. Another peak occurred in March 2017 when an offshore worker called for action after he and his colleagues were exposed to radiation on EnQuest’s Thistle platform off Shetland. Other than these peaks, the trends remain constant.

Trends for geographical search queries show surprisingly low levels in certain countries, especially Japan, which has advanced development in nuclear plants and facilities. Results for these countries who registered with low RSV may be due to their dominant use of their native language when using the search engines. A high search volume related to the query of radiation pole employ, which is one of the related search terms on radiation, also suggested the same issues. Pôle emploi (employment centre in English) is a French governmental agency that registers unemployed people, helps them find jobs and provides them with financial aid. This related search query of radiation registered a breakout search volume but France is not listed among the top, albeit few, countries with high RSV of the search term. Result may due to the language used when the French conduct a search on radiation. Undeniably, almost all countries (Australia, United States, Singapore, Canada and New Zealand) that displayed high levels of search queries use English as their official language, which may be one of the factors that contributed to high RSV of the search terms in these countries. The greater public interest towards all search terms in these countries may be due to the detection of a high level radiation, such as Canada which ranked as the fifth and sixth top country with high search queries on ‘radiation’ with detected trace amounts of Cesium-134 and Cesium-137 in samples collected off the coast of Ucluelet. The same is true for to Singapore, which yielded the highest RSV on the search term.

Table 2. Top five countries with highest RSV for each search term from February 2008 to February 2018 in Google Search

| Search term | Country      | RSV |
|-------------|--------------|-----|
| Radiation   | Singapore    | 100 |
|             | Philippines  | 92  |
|             | United States| 91  |
|             | Australia    | 88  |
|             | Nigeria      | 83  |
“radiation” detected with high UV Index (UVI), which is a measure of the level of UV radiation in an area. In contrast, the high levels of search queries may be also due to the varying policies amongst countries. For example, the Department of Health in the Philippines included the diagnosis and treatment of thyroid cancer under PhilHealth’s coverage.

Research on social media during natural disasters is an emerging area of enquiry that drew attention for media studies, emergency management, crisis information management and computer science [14]. In fact, as the relative volume of Internet searches for sample queries in any web-based tool, such as Google, Google News and Youtube, are likely to be correlated with Internet users’ perceived information needs. Future studies using web based search tools to investigate interest cycles should be further developed and it will be useful to plan interventions tailored to the local needs. Study designs and analytic tools more appropriate to estimate the effects of media coverage would also be of invaluable help. A further study in this field may eventually help in development of strategies and policies to increases public awareness towards radiation.

5. Limitation
Web access is still concentrated in (but not limited to) metropolitan areas, which would limit the use of GT in rural areas or regions with a low search volume that may affect the results. In addition, the language used as the search terms may limit the results in Google Trends for regional comparisons as there are countries who are not using English as their official language Nevertheless, potential of Google Trends to generate hypotheses about public awareness and interest is undeniable.

6. Conclusion
GT has been used successfully as an integrative tool for a traditional surveillance system for public interest towards a certain topic. The GT provide a platform and online database that is free and easily accessible for researchers compared to traditional surveys, particularly when the study involves a large population. We successfully identified the public interest cycle towards radiation over the recent 10 years (2008–2018) and confirm that in relation to radiation-related incidents or disaster.

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