American Journal of Preventive Cardiology 5 (2021) 100148

Contents lists available at ScienceDirect

American Journal of Preventive Cardiology

journal homepage: www.journals.elsevier.com/the-american-journal-of-preventive-cardiology

Short Report

Cardiovascular-related health behaviors and lifestyle during the COVID-19 pandemic: An infodemiology study

Omar Dzaye *, Siegfried Adelhoefer, Ellen Boakye, Michael J. Blaha

Johns Hopkins Ciccarone Center for the Prevention of Cardiovascular Disease, Johns Hopkins University School of Medicine, Baltimore, MD, United States

ARTICLE INFO

Keywords:
Infodemiology
Google trends
Primary prevention
Cardiovascular disease

ABSTRACT

Background: Reports have suggested decreasing attention to CVD comorbidities during the COVID-19 pandemic, despite their association with worse virus-related outcomes. Using nowcasting tools, we sought to explore temporal trends in public interest by studying use of online search terms related to CVD comorbidities during the pandemic time period.

Methods: We queried Google Trends for recent (October 2019–October 2020) and seasonal (October 2016–October 2020) trends of search terms pertaining to cardiovascular-related behaviors or clinical care including clinical diagnostic and therapeutic-related terms. Additionally, we acquired data from Google Shopping Insights to explore consumer behavior. Data for search results in the US were compared using mean relative search volumes (RSV), tabulated by month.

Results: Online search interest in the terms "Exercise" and "Cigarettes" changed by +18.0% and −52.5%, respectively, comparing March–April with January–February 2020. Key terms related to CVD-related care, including diagnostic and therapeutic-related terms such as "Statin", "Lipid profile", "Low-density lipoprotein", and "Hemoglobin A1C" declined to a four-year low in late March 2020 but regained pre-pandemic search query frequency by July 2020. Results were supported by Google Shopping analysis; for example, online consumer shopping-related searches for tobacco products reached at an all-year low after May 2020.

Conclusion: We report an increase in search interest for an overall healthier CVD-related lifestyle starting in March 2020, supported by online consumer shopping behavior. However, a months-long trough in public interest for CVD care-related search terms from March–May 2020 suggests a transient but substantial decrease in public focus on cardiovascular-related healthcare engagement. Future research is needed to understand if these mixed signals will persist into 2021 and how they potentially translate into real-world CVD-related event rates.

1. Introduction

With a broad range of elective procedures halted in order to free healthcare resources for the care of patients diagnosed with COVID-19, collateral effects on other healthcare services have been recently reported [1,2]. Hospitalizations for acute coronary syndrome (ACS) decreased during the early phase of the COVID-19 pandemic with an estimated 38% reduction in cardiac catheterization in the US alone [3]. Although seasonal variation in ACS hospitalizations and subsequent mortality have been described extensively [4–6], there now seems to be a concerning dissociation between declining ACS hospitalizations and simultaneously emerging evidence that ACS can occur as the first clinical manifestation of an active COVID-19 infection [7]. The declining ACS hospitalizations during the pandemic has been attributed to stay-at-home orders, people's fear of contracting the virus in the hospital setting, and the prioritization of COVID-19 patients and preferential reallocation of healthcare resources [8]. This decline raises the question of long-term consequences of withholding or delaying diagnostic and therapeutic options for patients suffering from CVD directly or from CVD-related comorbidities [9].

Public health surveillance has gained more widespread attention recently with Google Trends as one of the most common tools in exploring temporal, seasonal, and geographical trends of communicable [10–12] and non-communicable [13–15] diseases. Such analyses have

Abbreviations: ACS, Acute coronary syndrome; CVD, Cardiovascular disease; RSV, Relative search volume.

* Corresponding author. Ciccarone Center for the Prevention of Cardiovascular Disease, The Johns Hopkins Hospital, Blalock 524D1, 600 N Wolfe St, Baltimore, MD, 21287, United States.

E-mail address: odzaye@jhmi.edu (O. Dzaye).

https://doi.org/10.1016/j.ajpc.2021.100148

Received 10 October 2020; Received in revised form 7 January 2021; Accepted 9 January 2021

2666-6677/© 2021 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

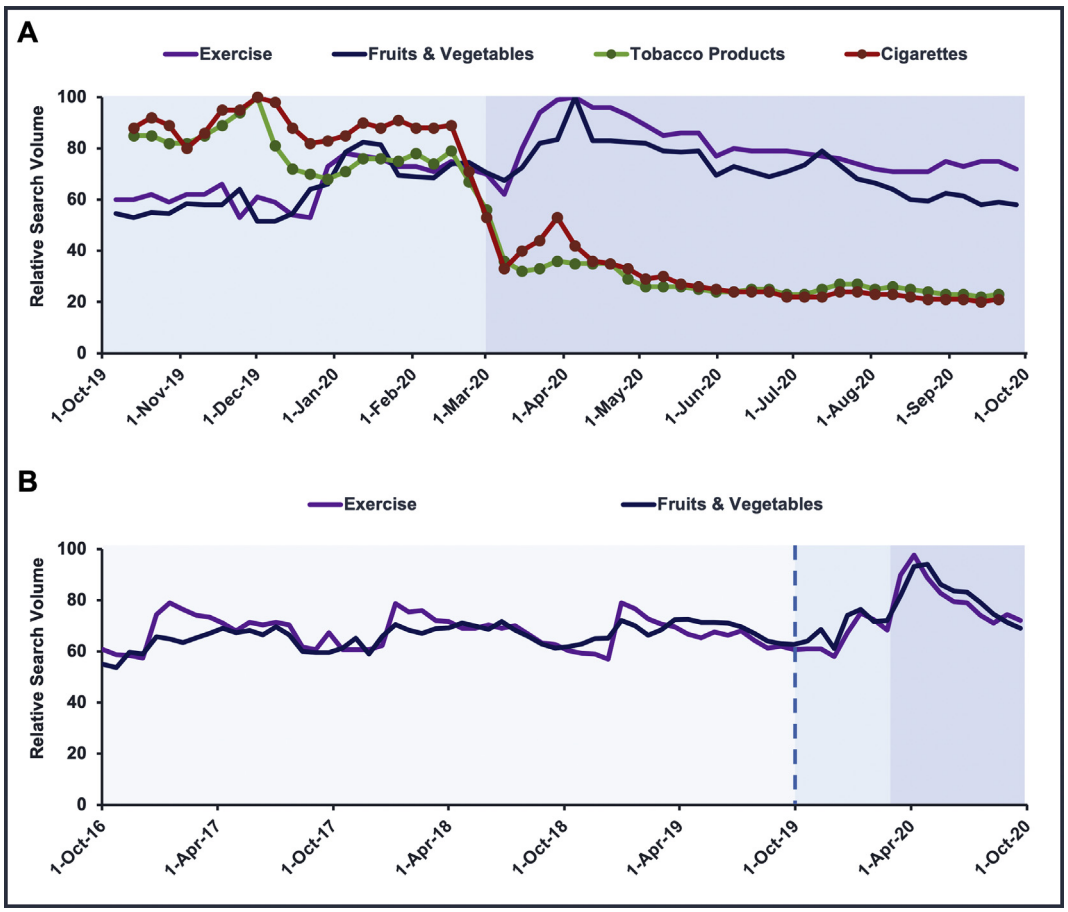

Fig. 1. US interest in search terms related to cardiovascular lifestyle and behavior, Google Trends RSV for the time periods (A) October 1, 2019 to October 1, 2020 presented as weekly data and (B) October 1, 2016 to October 1, 2020 averaged tri-weekly for common cardiovascular-related lifestyle and behavior terms, namely "Exercise" (purple), "Fruits & Vegetables" (dark blue), "Tobacco Products" (green), and "Cigarettes" (dark red). Lines with dotted markers indicate data from Google Shopping Insights; all other depicted lines represent data from Google Trends. Shaded area: World Health Organization (WHO) on March 11, 2020 has declared the COVID-19 outbreak a global pandemic. Dashed line in lower panel implicates start of upper panel to visualize transient trends amidst COVID-19 pandemic versus long-term seasonal trends. (Search query: October 5, 2020).

proved valuable in guiding epidemiologists and healthcare providers to maximize the effective allocation of healthcare resources [16]. As a result, infodemiology has emerged as a new research discipline dedicated towards studying the determinants and the distribution of health information [17].

In this study we explored potential changes in search interest in cardiovascular-related lifestyle, behaviors, and engagement with the healthcare system by accessing passively generated search engine data. We were particularly interested in understanding the potential net effects of COVID-19, a once in a generation natural experiment, on lifestyle change. We viewed our findings within the context of the known decline in ACS hospitalizations in early 2020, with gradual resumption of more normal clinical practice in the latter half of 2020.

2. Methods

We accessed Google Trends (https://trends.google.com/), a publicly available tool for identification of temporal and geographic patterns in search volume on the related search engine Google and affiliated sites. Beginning with basic terms such as "cardiovascular disease", the selection of search terms was then optimized by using the "Related searches"-function in Google Trends to identify other high-frequency search terms, and finally guided by consensus among the authors (Supplemental Table 1). Input on the Google Trends user-facing interface was queried either as a search term or – if available – as topic, diagnostic test, class of drug, or another category automatically assigned by Google Trends. Using such categories encompasses a broader selection of synonymous terms beyond the individual index search term. Google reports search volumes relative to a peak in a given time range and location, with search volume at all other time points reflecting a partial amount of that peak on a scale of 0–100. These numbers thus do not represent absolute search volume. Details on the methodology have previously been published elsewhere [18,19].

To present both recent and seasonal trends, we determined two distinct time ranges. For recent trends, we queried search terms from October 1, 2019 until October 1, 2020. To illustrate seasonal trends, we defined a time range from October 1, 2016 until October 1, 2020. To best illustrate seasonal trends and enable comparison of seasonal vs. transient trends since the WHO officially declared COVID-19 to a global pandemic (March 11, 2020), we studied data that has been additionally adjusted for seasonal variability. We extracted weekly relative search volume (RSV) data on searches in the US which reflect CVD-related behaviors. We additionally queried Google Shopping Insights (https://shopping.thinkwithgoogle.com/), another publicly available platform. Using the same methodology and a similar interface as Google Trends, Google Shopping provides data on consumer behavior. Sources of these aggregated data are Google Shopping and affiliated websites, thus reflecting online searches made with some degree of purchasing and consumption intention. Google Shopping Insights allows for searches of individual products as well as narrower and broader preassigned product categories. We used this tool to explore most recent trends in product categories related to cardiovascular health, specifically consumer searches for fruits

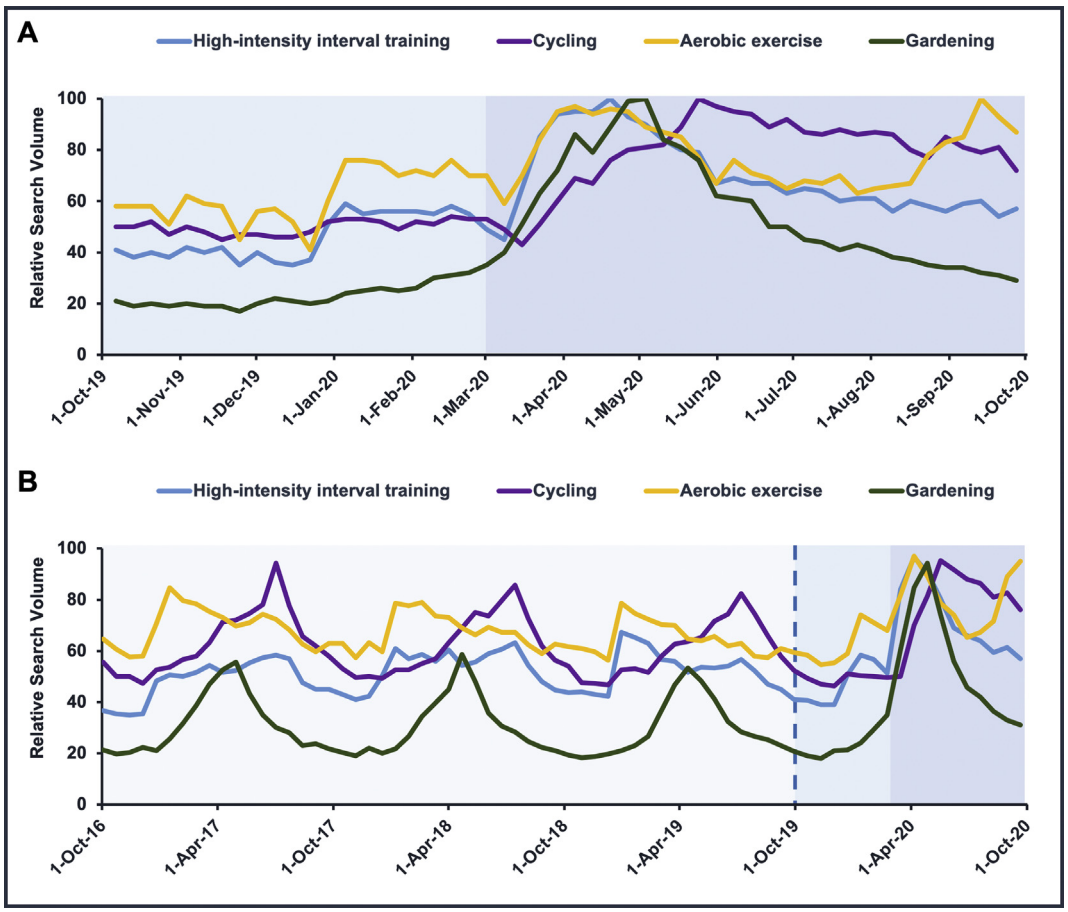

Fig. 2. US interest in exercise-related search terms; Google Trends RSV for the time periods (A) October 1, 2019 to October 1, 2020 presented as weekly data and (B) October 1, 2016 to October 1, 2020 averaged tri-weekly for common exercise-related search terms, namely "High-intensity interval training" (blue), "Cycling" (purple), "Aerobic exercise" (yellow), and "Gardening" (dark green). All depicted lines represent data from Google Trends. Shaded area: World Health Organization (WHO) on March 11, 2020 has declared the COVID-19 outbreak a global pandemic. Dashed line in lower panel implicates start of upper panel to visualize transient trends amidst COVID-19 pandemic versus long-term seasonal trends. (Search query: October 5, 2020).

and vegetables as well as tobacco products. Data from Google Shopping Insights are available only one year into the past; we therefore included data from Google Shopping Insights for recent trends but not for seasonal trends. This study utilized publicly available data without personal identifiers and was thus exempt from institutional review board approval.

3. Results

3.1. Trends in search interest in cardiovascular-related behaviors

We noted an increase in search volume for "Exercise" beginning in March 2020. The mean RSV of March and April was 18.0% higher than in the two preceding months. Similarly, search interest for "Fruits & Vegetables" also increased with the mean RSV up 7.7% in the same time range (Fig. 1 A). We report a consistent increase for a range of terms related to exercise since March 2020 (Fig. 2 A). When querying consumer search interest, we detected a sharp decline for tobacco products with an onset in mid-February 2020. Shopping searches fell by 51.2% and 52.5% for "Tobacco Products" and "Cigarettes", respectively, and have not recuperated since (Fig. 1 A, Supplemental Table 2).

Long-term search interest confirms seasonal trends for the search topic "Exercise" with the mean RSV in the first two months of the year (2020) being 23.3% higher than the mean RSV of October–December 2019. Search interest for "Fruits & Vegetables" is also higher at the beginning of each year although changes are smaller with the mean RSV of January and February up 30.8%, 7.3%, 10.3%, 11.9% compared with the final three months of 2019, 2018, 2017, and 2016 (Fig. 1 B, Supplemental Table 2). We also observed seasonality for exercise-related search terms. Search interest for "High-intensity interval training" and "Aerobic exercise" peaks at the beginning of the year, whilst search interest for "Gardening" and "Cycling" peaks in spring and in summer, respectively (Fig. 2 B). However, changes during the pandemic in 2020 have magnified or exceeded seasonal trends.

3.2. Trends in CVD-related diagnostic and therapeutic search terms

Starting in January 2020, search query volume increased for search terms related to clinical diagnostic and therapeutic options for CVD comorbidities, followed by a decrease in March and April (Fig. 3 A). Comparing the mean RSV of March and April 2020 with the first two months of 2020, we report changes of −35.7%, −19.4%, −43.9%, −38.4%, and −34.4% for the search terms "Statin", "Metformin", "Lipid profile", "Low-density lipoprotein", and "Hemoglobin A1C", respectively. RSV fell to a four-year low for the search terms "Statin", "Lipid profile", "Low-density lipoprotein", and "Hemoglobin A1C" (Fig. 3 B). Search interest has recuperated since then with changes of +20.7%, +33.7%, +47.5%, +29.8%, and +31.8% in the following five months and in the same order of search terms as above (Supplemental Table 3).

4. Discussion

Using data from Google Trends for the US, we report a sudden increase in online searches for an overall healthier lifestyle with the onset

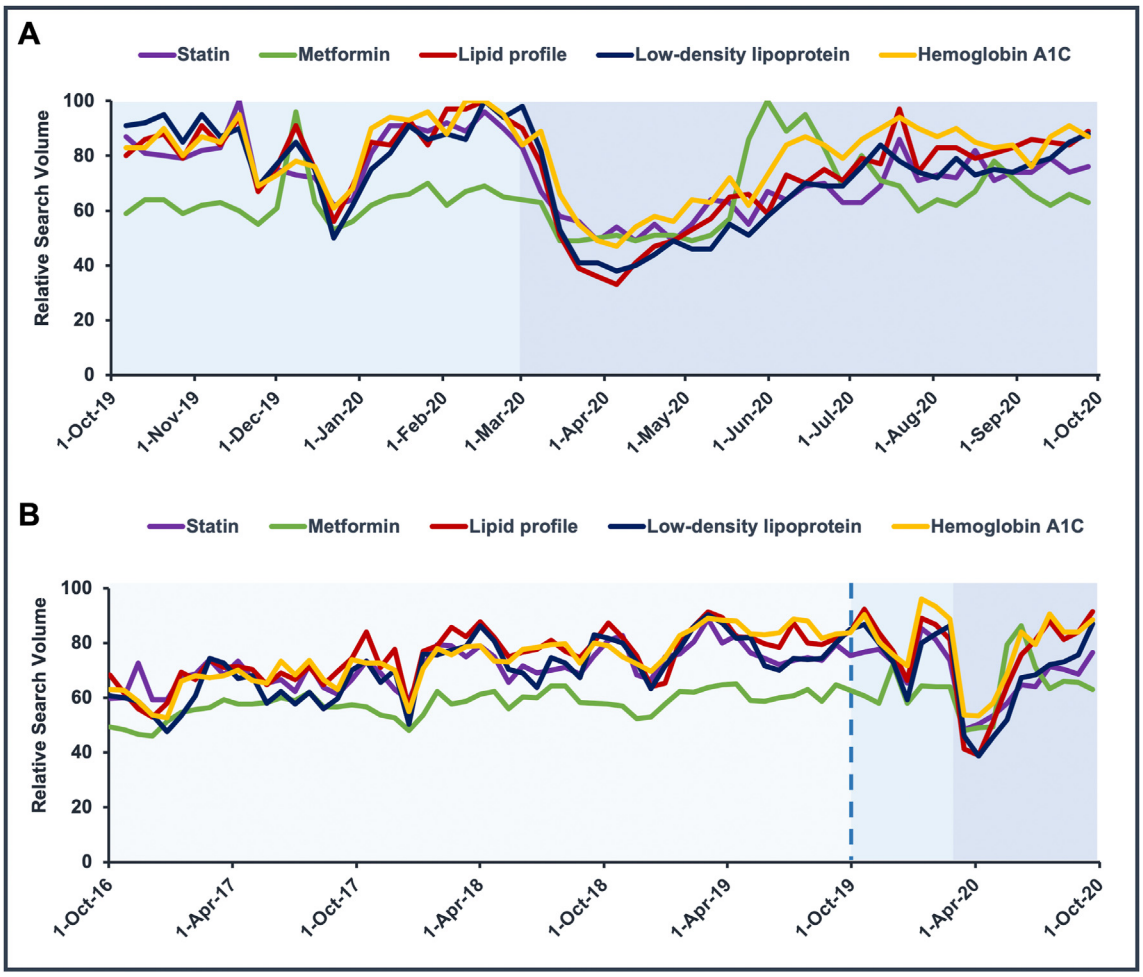

Fig. 3. US interest in search terms related to diagnostic and therapeutic options of CVD comorbidities. Google Trends RSV for the time periods (A) October 1, 2019 to October 1, 2020 presented as weekly data and (B) October 1, 2016 to October 1, 2020 averaged tri-weekly for common CVD-related diagnostic and therapeutic options, namely "Statin" (purple), "Metformin" (green), "Lipid profile" (dark red), "Low-density lipoprotein" (dark blue), and "Hemoglobin A1C" (yellow). All depicted lines represent data from Google Trends. Shaded area: World Health Organization (WHO) on March 11, 2020 has declared the COVID-19 outbreak a global pandemic. Dashed line in lower panel implicates start of upper panel to visualize transient trends amidst COVID-19 pandemic versus long-term seasonal trends. (Search query: October 5, 2020).

of the COVID-19 global pandemic. This includes an increase in search query frequency related to physical exercise as well as products related to a healthier diet. At the same time, we observed a decrease of consumer searches for products related to smoking. However, over the same time period, search volume for clinical diagnostic and therapeutic options for CVD comorbidities, which may be proxies for healthcare system engagement, decreased considerably starting in March 2020.

4.1. *Trends in searches related to lifestyle and dietary behaviour*

Seasonal peaks for exercise-related search terms occurred at the beginning of each year with a subsequent decline towards the end of each year. However, exploring year over year changes we report an increase in exercise-related search interest reaching a 4-year peak in March and April 2020. While seasonal peaks in exercise-related search terms occurred in January and February in most years, which may be due to people's new year resolutions to keep fit, the recent (2020) peak occurred in March and April. Seasonality for increased online search interest in exercise and an increased tendency to exercise more may partly be attributable to warmer temperatures in the US. This coincides with when most states in the US went on lockdown due to surges in COVID-19 cases. The COVID-19 pandemic may therefore play a key role in this observation. There is reason to assume that a higher search volume for exercise-related terms results in subsequent changes in individual behaviour [20].

When querying for consumer behavior on Google Shopping and affiliated websites, we detected an increased online search interest in a healthier nutrition nationwide. Since March 2020, shopping searches for fruits and vegetables have increased. The application and benefits of varying nutritional protocols emphasize the role of fruits and vegetables and can contribute to CVD prevention [21–23].

A decrease in consumer search interest in tobacco products and cigarettes remained at a one-year low and did not recuperate. Earlier reports suggested that COVID-19 patients with history of smoking were at an increased risk of severe disease and adverse outcomes [24]. This may have contributed to the observed decrease in consumer search interest in tobacco products. This is a positive signal for prevention of CVD and other smoking-associated diseases.

4.2. *Trends in CVD-related diagnostic and therapeutic search terms*

Search interest for CVD-related diagnostic and therapeutic search terms reached a four-year peak in February 2020 before rapidly declining throughout March and April 2020. The peak may be a result of increased awareness during the American Heart Month in February established by the United States Code. This observation may thus stand as yet another example in the broader theme of linking health-related awareness

campaigns with an increase in public interest. This has previously been shown for the impact of Breast Cancer Awareness Month in October on search engine volume [25,26] and the subsequent increase in breast cancer diagnoses has been well documented [27,28]. An increase in public interest in colorectal cancer based on Google search volume has also been linked to the National Colorectal Cancer Awareness Month. This has, however, not yet translated into an increase in screening [29].

Concerningly, search interest in a range of terms related to diagnostic and therapeutic options of CVD comorbidities, which may be proxies for healthcare system engagement, decreased throughout March and April 2020. This decrease may partly be explained by the decrease in outpatient care and decreased laboratory measurements as a consequence of lockdowns and quarantine. Previously, a decline in online search interest for search terms related to diagnostic imaging has been reported [30]. Data from Google Trends may point to real-world developments as has been shown by a strong correlation between online search volume for the search term "chest pain" and COVID-19 caseloads stratified by US states [31]. This is consistent with reports of decreasing attention to the care of CVD comorbidities during the COVID-19 pandemic, despite evidence of increased risk and worse virus-related outcomes for persons with CVD comorbidities. Comorbidities in patients with laboratory-confirmed COVID-19 were previously reported as common in a multicentre cohort of 191 patients in China. Hypertension was the most common comorbidity, followed by diabetes and coronary heart disease. The authors reported a higher in-hospital mortality in the presence of coronary heart disease even after multivariable adjustment (OR 2.14, 95% CI 0.26–17.79) [32]. Patients with cardiovascular or metabolic comorbidities seem to have a predisposition for developing a more severe COVID-19 infection [33]. The rising mortality from diabetes in the US to a 4-year high in April 2020 seem to confirm these early findings. Clinical implications for the management of patients with COVID-19 and diabetes have recently been published [34].

Unlike the sustained changes in search interest for cardiovascular-related lifestyle and therapeutic behaviors, the decrease in search interest for clinical CVD care was transient and started increasing in May. This may be explained by the halt in elective and non-essential procedures for several weeks during the early period of the pandemic. It seems plausible that the delay in care of CVD comorbidities may particularly put those patients at risk who did not receive adequate care before the onset of the pandemic, one scenario being that a fraction of patients was just in the diagnostic stage of comorbidities. It is thus a positive sign that search interest and as a possible consequence diagnostic procedure in healthcare facilities are recuperating.

4.3. Adjusting to an increase in CVD care

The increase in search interest in care for CVD comorbidities raises hope from a standpoint of patient awareness, education and re-engagement with the healthcare system. The decrease in ACS cases, as reported earlier [8], was likely a complicated composite of lifestyle change and reduced healthcare engagement due to people's fear of contracting the virus while seeking medical care. With the lifting of restrictions and evidence of patients' re-engagement with the healthcare system, there could be a surge in ACS cases and other CVD comorbidities.

The increase in search interest in care for CVD comorbidities may be an early indicator for an increase in demand for CVD care in upcoming months that healthcare personnel must start preparing for. This has been recognized in the care of e.g. patients diagnosed with breast cancer for whom a risk-stratified prioritization algorithm has recently been put forward [35]. While there is ample evidence emerging on the care of CVD patients during the pandemic [36,37], the effective use of healthcare resources in post-pandemic times with months-long delays in diagnostic and therapeutic procedures currently remains an unsolved problem that needs urgent attention.

4.4. Limitations

Several limitations of our study should be noted. First, as part of this study we gathered data from two different sources and thus, slight variations in the definition of time ranges may exist. Second, in its nature Google Trends may have a representative bias towards a younger and more educated population. Google Trends is thus no substitute for traditionally gathered data from population-based surveys. Third, tracking shopping behavior during the pandemic might be difficult due to potential shift from in person to online purchase. Fourth, data from Google Trends may be interpreted with caution. News reports on health-related topics and other (social) media attention can have a significant impact on search volume and need not to be underestimated [38]. We explored any additional peaks or troughs in our data to rule out real-world occurrences that may have impacted our data. To avoid confounding of singular spikes, we calculated a three-week moving average for our data spanning a time range of four years. Overall, we believe that our carefully chosen search terms have captured a representative overview of long-term and recent trends in CVD infodemiology.

5. Conclusion

Lifestyle habits and health awareness fluctuate with societal changes and the seasons over time. The COVID-19 pandemic has had a great impact on the seasonal cycle and led to an increased search interest for a healthier lifestyle that appears to remain robust. However, potential collateral damage due to months-long reduction in pursuit of non-emergent but nonetheless important care for CVD comorbidities appears likely. With a returning public interest in CVD related diagnostic and therapeutic procedures – proxies of healthcare system engagement – our data point to the need for thoughtful planning and risk-based strategies to support maintenance of lifestyle change while effectively deploying our available healthcare resources to patients at highest risk of CVD.

Funding

Research reported in this publication was supported by the National Heart, Lung, and Blood Institute of the National Institutes of Health and the US Food and Drug Administration's Center for Tobacco Products (U54HL120163). The content is solely the responsibility of the authors and does not necessarily represent the official views of the study sponsors.

Disclosures

The authors declare that they have no conflicts of interest relevant to the content of this manuscript.

Author contributions

OD and MJB participated in the conception and design of the study and drafted the manuscript. OD and SA conducted the analyses and prepared the tables and figures. SA and EB participated in the interpretation of the data, drafting of the manuscript, and revised subsequent drafts critically for important intellectual content. All authors approved the final version.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajpc.2021.100148.

References

[1] Lange SJ, Ritchey MD, Goodman AB, et al. Potential indirect effects of the COVID-19 pandemic on use of emergency departments for acute life-threatening conditions - United States, January-May 2020. MMWR Morb. Mortal. Wkly. Rep. 2020;69:795–800.

[2] Metzler B, Siostrzonek P, Binder RK, Bauer A, Reinstadler SJ. Decline of acute coronary syndrome admissions in Austria since the outbreak of COVID-19: the pandemic response causes cardiac collateral damage. Eur. Heart J. 2020;41:1852–3.

[3] Garcia S, Albaghdadi MS, Meraj PM, et al. Reduction in ST-segment elevation cardiac catheterization laboratory activations in the United States during COVID-19 pandemic. J. Am. Coll. Cardiol. 2020;75:2871–2.

[4] Spencer FA, Goldberg RJ, Becker RC, Gore JM. Seasonal distribution of acute myocardial infarction in the second National Registry of Myocardial Infarction. J. Am. Coll. Cardiol. 1998;31:1226–33.

[5] Crawford VL, McCann M, Stout RW. Changes in seasonal deaths from myocardial infarction. QJM 2003;96:45–52.

[6] Cheng TO. Mechanism of seasonal variation in acute myocardial infarction. Int. J. Cardiol. 2005;100:163–4.

[7] Schiavone M, Gobbi C, Biondi-Zoccai G, et al. Acute coronary syndromes and covid-19: exploring the uncertainties. J. Clin. Med. 2020;9.

[8] Huynh K. Reduced hospital admissions for ACS - more collateral damage from COVID-19. Nat. Rev. Cardiol. 2020;17:453.

[9] Stefanini GG, Montorfano M, Trabattoni D, et al. ST-elevation myocardial infarction in patients with COVID-19: clinical and angiographic outcomes. Circulation 2020;141:2113–6.

[10] Zhang Y, Yakob L, Bonsall MB, Hu W. Predicting seasonal influenza epidemics using cross-hemisphere influenza surveillance data and local internet query data. Sci. Rep. 2019;9:3262.

[11] Crowson MG, Witsell D, Eskander A. Using Google trends to predict pediatric respiratory syncytial virus encounters at a major health care system. J. Med. Syst. 2020;44:57.

[12] Liu DT, Besser G, Leonhard M, et al. Seasonal variations in public inquiries into laryngitis: an infodemiology study. J. Voice 2020.

[13] Wu Q, Xu Z, Dan YL, et al. Seasonality and global public interest in psoriasis: an infodemiology study. Postgrad. Med. 2020;96:139–43.

[14] Teng Y, Huang SW, Li Z, et al. Seasonal variation and trends in the Internet searches for losing weight: an infodemiological study. Obes. Res. Clin. Pract. 2020;14:225–33.

[15] Liu DT, Besser G, Parzefall T, Riss D, Mueller CA. Winter peaks in web-based public inquiry into epistaxis. Eur. Arch. Oto-Rhino-Laryngol. 2020;277:1977–85.

[16] Mavragani A, Ochoa G, Tsagarakis KP. Assessing the methods, tools, and statistical approaches in Google trends research: systematic review. J. Med. Internet Res. 2018;20:e270.

[17] Eysenbach G. Infodemiology and infoveillance: framework for an emerging set of public health informatics methods to analyze search, communication and publication behavior on the Internet. J. Med. Internet Res. 2009;11:e11.

[18] Google. Google trends help. 2020, https://support.google.com/trends/. [Accessed 28 July 2020].

[19] Mavragani A, Ochoa G. Google trends in infodemiology and infoveillance: methodology framework. JMIR Public Health Surveill 2019;5:e13439.

[20] Madden KM. The seasonal periodicity of healthy contemplations about exercise and weight loss: ecological correlational study. JMIR Public Health Surveill 2017;3:e92.

[21] Migliaccio S, Brasacchio C, Pivari F, et al. What is the best diet for cardiovascular wellness? A comparison of different nutritional models. Int. J. Obes. Suppl. 2020;10:50–61.

[22] Rees K, Takeda A, Martin N, et al. Mediterranean-style diet for the primary and secondary prevention of cardiovascular disease. Cochrane Database Syst. Rev. 2019;3:Cd009825.

[23] Pallazola VA, Davis DM, Whelton SP, et al. A clinician's guide to healthy eating for cardiovascular disease prevention. Mayo Clin Proc Innov Qual Outcomes 2019;3:251–67.

[24] Vardavas CI, Nikitara K. COVID-19 and smoking: a systematic review of the evidence. Tob. Induc. Dis. 2020;18:20.

[25] Rosenkrantz AB, Prabhu V. Public interest in imaging-based cancer screening examinations in the United States: analysis using a web-based search tool. AJR Am. J. Roentgenol. 2016;206:113–8.

[26] Hao Z, Liu M, Ge X. Evaluating the impact of health awareness events on Google search frequency. Prev Med Rep 2019;15:100887.

[27] Jacobsen GD, Jacobsen KH. Health awareness campaigns and diagnosis rates: evidence from national breast cancer awareness month. J. Health Econ. 2011;30:55–61.

[28] Karabay O, Hasbahceci M, Kadioglu H. Impact of breast cancer awareness month on detection of breast cancer in a private hospital. J. Int. Med. Res. 2018;46:619–25.

[29] Pantel HJ, Kleiman DA, Kuhnen AH, Marcello PW, Stafford C, Ricciardi R. Has National Colorectal Cancer Awareness Month increased endoscopy screening rates and public interest in colorectal cancer? Surg. Endosc. 2020.

[30] Adelhoefer S, Henry TS, Blankstein R, Graham G, Blaha MJ, Dzaye O. Declining interest in clinical imaging during the COVID-19 pandemic: an analysis of Google Trends data. Clin. Imag. 2020;73:20–2.

[31] Ciofani JL, Han D, Allahwala UK, Asrress KN, Bhindi R. Internet search volume for chest pain during the COVID-19 pandemic. Am. Heart J. 2021;231:157–9.

[32] Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet 2020;395:1054–62.

[33] Li B, Yang J, Zhao F, et al. Prevalence and impact of cardiovascular metabolic diseases on COVID-19 in China. Clin. Res. Cardiol. 2020;109:531–8.

[34] Gupta R, Ghosh A, Singh AK, Misra A. Clinical considerations for patients with diabetes in times of COVID-19 epidemic. Diabetes Metabol. Syndr. 2020;14:211–2.

[35] Smith BL, Nguyen A, Korotkin JE, et al. A system for risk stratification and prioritization of breast cancer surgeries delayed by the COVID-19 pandemic: preparing for re-entry. Breast Canc. Res. Treat. 2020.

[36] Mariani S, Hanke JS, Dogan G, Schmitto JD. Out of hospital management of LVAD patients during COVID-19 outbreak. Artif. Organs 2020;44:873–6.

[37] Bhaskar S, Rastogi A, Chattu VK, et al. Key strategies for clinical management and improvement of healthcare services for cardiovascular disease and diabetes patients in the coronavirus (COVID-19) settings: recommendations from the REPROGRAM consortium. Front. Cardiovasc. Med. 2020;7:112.

[38] Cervellin G, Comelli I, Lippi G. Is Google Trends a reliable tool for digital epidemiology? Insights from different clinical settings. J. Epidemiol. Glob. Health 2017;7:185–9.