

# Effectiveness of Breast Cancer Awareness Month (BCAM) Before and After the COVID-19 Pandemic: Google Trends Analysis

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## ABSTRACT

**Background:** Breast cancer awareness month (BCAM) strategy has been established in Saudi Arabia to promote national knowledge about Breast Cancer, as the Saudi Cancer Registry annual reports reported that breast cancer has ranked first among other cancerous diseases in women. Early detection and the treatment in the early stages of the disease will increase the survival rate of breast cancer patients. Many detection techniques have been used for breast cancer. The objectives of this study are to investigate the popular pattern in seeking screening information of breast cancer in Saudi Arabia using Google Trends.

**Methods:** Data from January 2012 to December 2022 were analyzed for "breast cancer" and "Mammogram" searches. A difference-in-differences design compared pre- and post-COVID-19 search volumes. Ethical approval was obtained, and statistical analysis was conducted using SAS.

**Results:** Over a decade, interest in breast cancer and mammograms in Saudi Arabia increased steadily. However, during the COVID-19 pandemic, there was a significant decline in both searches. Breast cancer searches decreased notably post-pandemic ( $p = 0.007$ ), while mammogram searches declined but not significantly ( $p = 0.31$ ). Regional disparities in search volumes were observed.

**Conclusion:** Several awareness campaigns especially in the country sides are essential to help increase public awareness and interest.

**Key words:** Google trends, Breast cancer, pandemic, awareness, public interest

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## INTRODUCTION

Breast cancer remains the most common cancer among women worldwide and a leading cause of cancer-related deaths, including in Saudi Arabia.<sup>1,2</sup> According to the Saudi Cancer Registry (SCR), breast cancer accounted for 32.2% of all cancers among Saudi females in 2017, with younger women aged 30–44 years experiencing the highest incidence rates.<sup>3,4</sup> Breast cancer incidence globally increases, with a significant number of patients in low- and middle-income countries experiencing advanced or metastatic stages.<sup>5,6</sup> Early detection of breast cancer is essential for improving survival outcomes, as timely diagnosis significantly enhances treatment effectiveness and reduces mortality rates. Globally, Breast Cancer Awareness Month (BCAM), observed every October, has emerged as a critical initiative to raise awareness, promote early screening, and improve survival rates for women diagnosed with the disease.

Despite these efforts, several barriers hinder early detection and effective management of breast cancer in Saudi Arabia. Social stigma around discussing breast health, economic disparities, and inconsistent access to healthcare services create obstacles to timely diagnosis and treatment.<sup>7</sup> For instance, mammography a key diagnostic tool has high specificity for early breast cancer detection but is often unavailable in rural or underserved areas.<sup>8,9</sup> Consequently, many women in rely on self-examinations to detect abnormalities, frequently leading to delayed diagnoses at more advanced stages of the disease. Overcoming these barriers requires targeted awareness campaigns, equitable healthcare resources, and a better understanding of public engagement with breast cancer information.

In recent years, internet access and the use of digital platforms have grown exponentially in Saudi Arabia, offering new opportunities to enhance health awareness. By 2022, nearly 98% of the Saudi population had internet access, and over 82% actively used social media. Notably, 51% of online searches in the Kingdom are health-related, with many individuals seeking information about diseases, symptoms, treatments, and management options.<sup>10,11</sup> This widespread digital engagement suggests the potential of using internet-based tools to monitor public interest in health issues and assess the reach of awareness campaigns like BCAM.<sup>12</sup>

Google Trends (GT), a powerful tool for analyzing search engine data, provides insights into public interest by tracking keyword search volumes over specific regions and time frames. This tool has been applied in various fields, including epidemiology, to monitor disease patterns and public awareness. In the context of breast cancer, Google Trends can help identify fluctuations in public interest, evaluate the effectiveness of BCAM campaigns, and understand the impact of global events such as the COVID-19 pandemic on awareness efforts.<sup>13,14</sup>

This study aims to utilize Google Trends to explore search patterns related to breast cancer in Saudi Arabia from January 2012 to December 2022. By analyzing public interest data, we seek to assess the effectiveness of BCAM in raising awareness, examine the geographical disparities in search activity, and evaluate the impact of the COVID-19 pandemic on public engagement with breast cancer awareness. The findings will provide valuable insights into public behavior, inform strategies for enhancing early detection programs, and support efforts to address gaps in awareness and healthcare accessibility across the Kingdom. Such insights could ultimately contribute to reducing the burden of breast cancer and improving survival outcomes for women in Saudi Arabia.

## METHODOLOGY

**Google Trends Tool:** Google Trends (GT) is a website by google that provides data on the temporal trends of search queries and is publicly available tool. It is used by the general population that have submitted the keyword phrases *via* the Google search engine, using weekly relative search volume (RSV). Google trends show the change in interest in a topic over time and regional interest. RSV has been calculated weekly by Google Trends based on the search terms that were entered in Google relative to the total search volume.<sup>15</sup> Unlike traditional metrics such traditional survey methods or structured interviews, Google Trends doesn't display total numbers of searches over time, instead it provides population-adjusted data reflecting the popularity of the search at a given time.<sup>16</sup> The use of Google Trends in public health research studies is increasing, which provides useful information about epidemiological surveillance, health screening pattern, and treatment options.<sup>17</sup> Overall, GT is a cost-effective tool for understanding public interest, providing open access to aggregated and anonymized search data. It captures large-scale coverage, allowing for temporal and geographic insights. It's particularly useful in epidemiology and public health, monitoring public interest, predicting disease outbreaks, and assessing awareness campaigns, especially for breast cancer awareness efforts.<sup>15-17</sup> However, it has biases like digital access disparity, regional variations in internet use, search engine preference bias, and keyword dependence. It primarily reflects internet-accessible individuals, excluding those with limited access and lower socioeconomic backgrounds.

**Retrieving Google Trends data:** The Google Trends tool was used on November 29, 2022, to retrieve data on internet user search activities in the context of breast cancer from google trends ([www.google.com/trends](http://www.google.com/trends)). Saudi Arabia Google Trends indicators were retrieved from January 2012 to December 2022 onward using the search terms, "breast cancer" and "Mammogram" and in Arabic "سرطان الثدي" "شعبة كشف الثدي". We used both Eng-

lish and Arabic languages as key-term search indicator. Using weekly data, yearly average Google Trends indicators were calculated for the years 2012 to 2022 and used to describe the annual trend in the data before and after the COVID19 pandemic. It is important to note that none of the queries in the Google database for this study can be associated with a particular individual. The database does not retain information about the identity, IP address, or specific physical location of any user.

**Ethical Approval:** We used Google Trends (Google LLC, Mountain View, CA, USA) a public use data available through [www.google.com/trends](http://www.google.com/trends). The study was approved by the institutional review board (IRB) of King Abdullah International Medical Research Center with a waiver for informed consent as the study intended to analyze unidentified public data retrospectively. All research methods were performed following relevant guidelines and regulations.

**Statistical Analysis:** We used frequency table to display the annual search volume for breast cancer and mammogram in Saudi Arabia between 2012 to 2022. Then, we used a difference-in-differences study design to compare the weekly changes in breast cancer and mammogram search volume before and after the COVID19 pandemic. We generated a binary variable to classify the data into before the pandemic period (from 01/03/2018 to 01/03/2020) and after the pandemic period (from 02/03/2018 to 01/3/2022). We also used a seasonal model to account for the seasonal pattern of the response series. The values of the series at the same time of year in

previous years is important for modeling the current seasonal model.<sup>18</sup> The before- and after-period measures was matched by month of October in each year to remove any spurious findings generated by differing outcome trajectories over the course of the year. We further used a repeated generalized linear model to estimate the mean differences before and after the COVID19 pandemic. All analyses were conducted in SAS. With 2-sided, unpaired testing, findings were considered significant at  $p < 0.05$ .

## RESULTS

**Public Interest in Breast Cancer and Mammogram over 10 years (2012-2022):** The results display the trends of breast cancer over 10 years. Saudi Arabia Google Trends index for breast cancer interest has increased constantly from 24.41 (7.13%) to 33.83 (9.88%) from 2012 to 2022. Similar patterns were observed for mammogram search volume that increased from 158.23 (8.29%) in 2012 to 182.31 (9.56) in 2022. In terms of the COVID-19 pandemic, there was a significant decline in the search volume index for both breast cancer interest and mammogram from 38.08 (11.13%) in 2019 to 28.16 (8.23%) in 2020, and from 178.53 (9.36%) in 2019 to 171.53 (8.99%) in 2020 respectively (Table1, Figure1).

**Aggregated years (2012-2022) by month:** In the aggregated months for all included years, for both breast cancer and mammogram search volume, there was a consistent seasonal trend in October or the Breast Cancer Awareness Month during the study period from 2012 to 2022 (Figure2).

**Table 1: The respective year, total number of search queries for breast cancer and mammogram search volume using Google Trends Saudi Arabia**

Year	Breast cancer Search volume	Breast cancer (%) <sup>1</sup>	Mammogram Search volume	Mammogram (%)
2012	24.41	7.13	158.23	8.29
2013	27.33	7.98	163.53	8.57
2014	26.16	7.64	169.69	8.89
2015	33.41	9.76	170.53	8.94
2016	33.83	9.88	183.83	9.63
2017	34.5	10.08	173.31	9.08
2018	34.75	10.15	178.07	9.33
2019	38.08	11.13	178.53	9.36
2020	28.16	8.23	171.53	8.99
2021	27.83	8.13	178.38	9.35
2022	33.83	9.88	182.31	9.56

<sup>1</sup>year search volume divided by total years search volume

**Table 2: Difference-in-difference estimates of changes in breast cancer and mammogram public interest before and after the COVID19 pandemic**

Search term	Average search volume before vs after the COVID19 pandemic Estimate coefficient	Confidence interval (95% CI)	P-value <sup>1</sup>
<b>Breast cancer</b>			
Before the pandemic	Reference group	Reference group	Reference
After the pandemic	-0.51	(-6.72, -1.63)	0.007
<b>Mammogram</b>			
Before the pandemic	Reference group	Reference group	Reference
After the pandemic	-11.26	(-33.09, 10.57)	0.31

<sup>1</sup>Generalized linear model

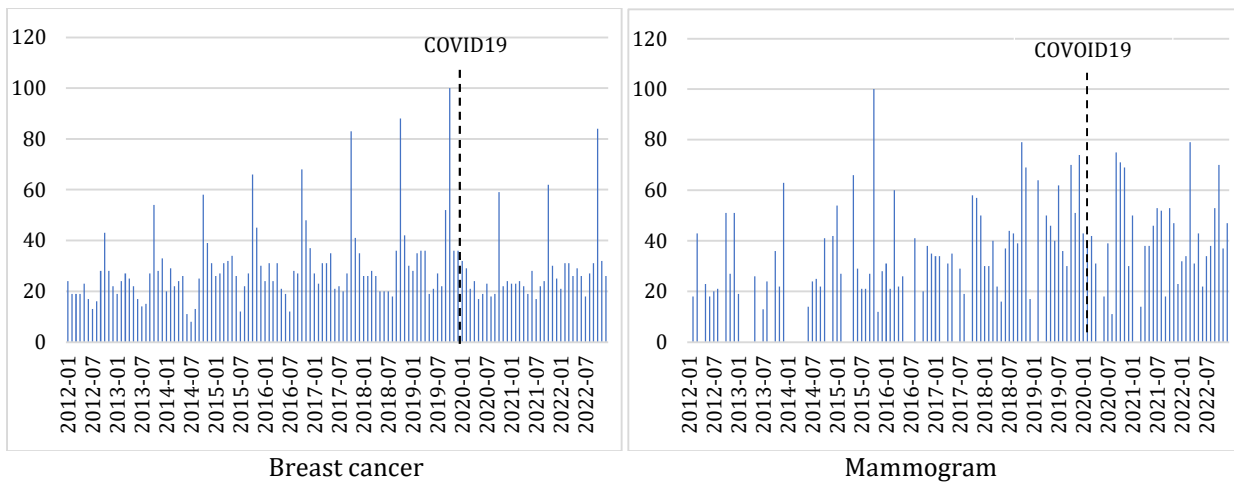


Figure 1: Monthly search volume

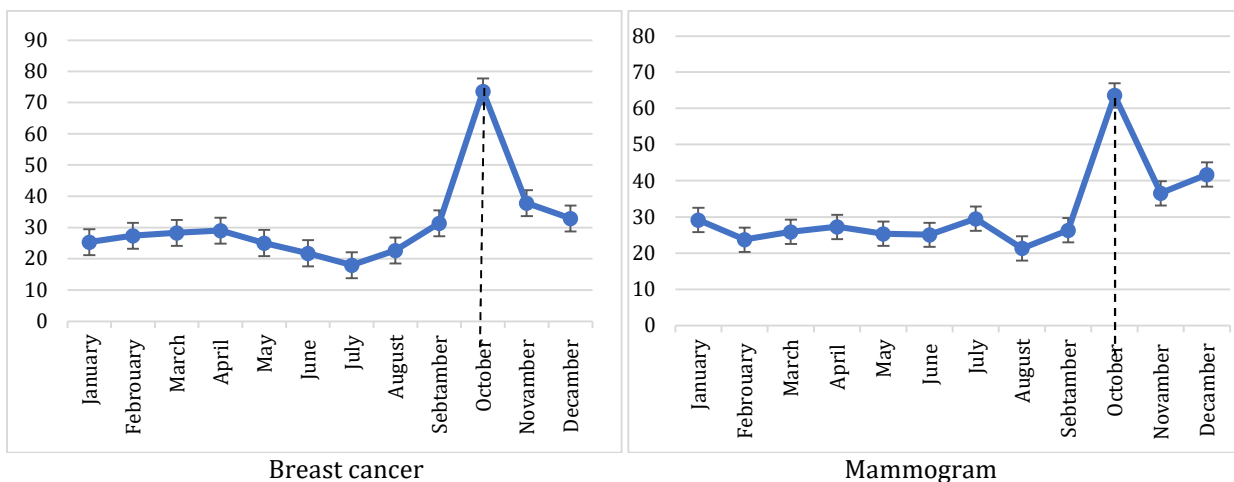


Figure 2: Aggregated monthly average search volume

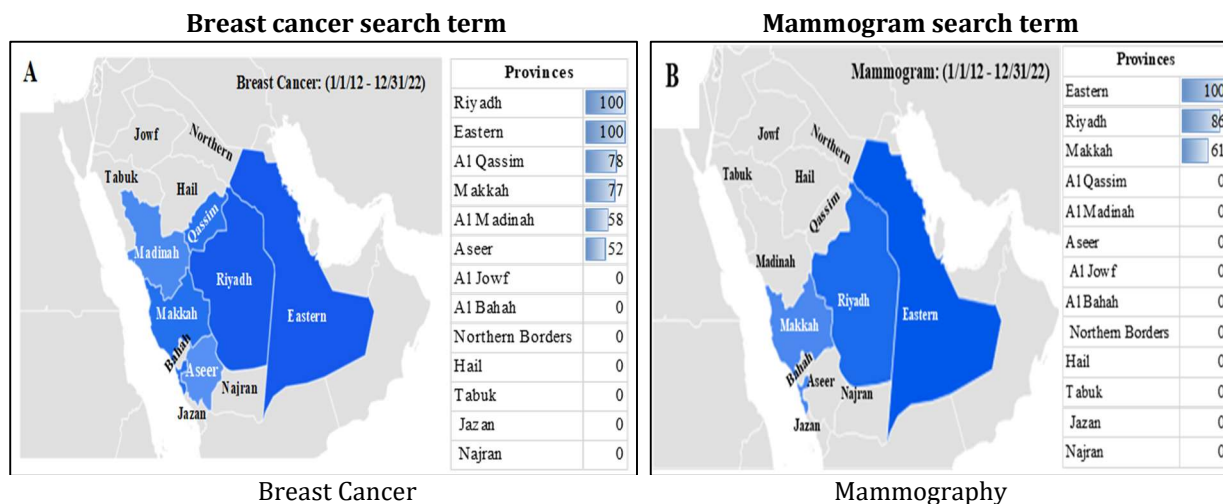
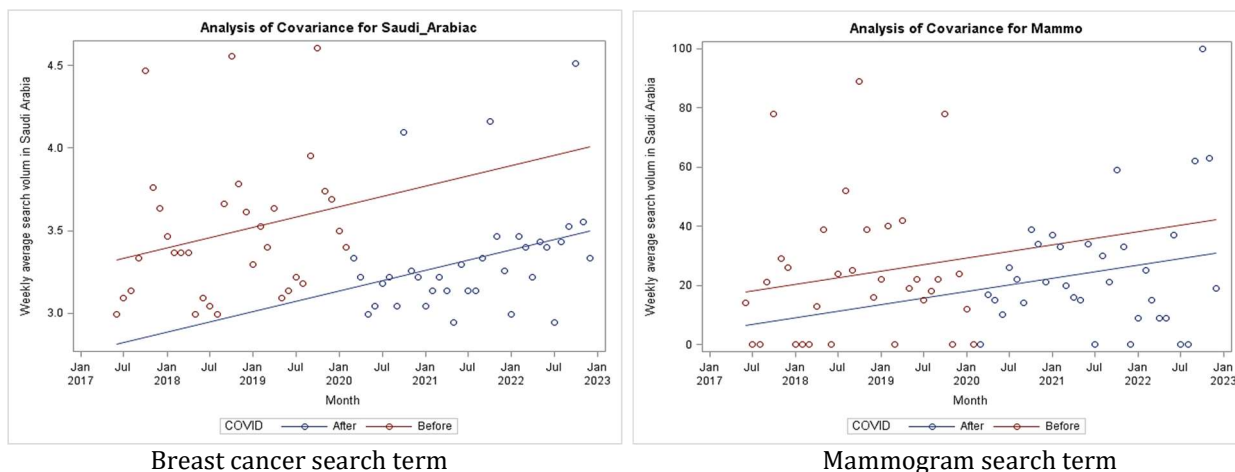


Figure 3: Search volume by region

In addition, for breast cancer search volume, Riyadh region represented the highest search volume compared to other regions. While, in mammogram search, Eastern region has the highest search volume (Figure3).

**Before and after the COVID-19 pandemic:** There was a statistically significant difference in breast cancer search volume after the pandemic. Breast

cancer search volume has decreased significantly after the pandemic (Estimate -0.5; Confidence interval (-6.72, -1.63); p-value 0.007). There was a 0.51 unit decrease in breast cancer search volume. There was a decrease in mammogram search, volume after the COVID19 pandemic, but it was not statistically significant (Estimate -11.26; Confidence interval (-33.09, 10.57); p-value 0.31) (Table 2, Figure 4).



**Figure 4: Average search volume before and after COVID-19 pandemic**

## DISCUSSION

Google Trends helps predict present trends in marketing and healthcare, including vaccination compliance and cancer prevention interest.<sup>19,20</sup> In this study, we investigated the efficacy of Google Trends tool to identify cycles of public interest in breast cancer search from 2012 to 2022 in Saudi Arabia including all regions. This study also compares public interest in breast cancer search before and after the COVID-19 pandemic. By identifying trends in public searches, we demonstrate the potential of Google Trends to inform public health planning and awareness campaigns during of Breast Cancer Awareness Month (BCAM). BCAM is an annual campaign conducted globally each October, aiming to increase awareness about breast cancer through activities such as community events, media campaigns, and health education initiatives. These efforts often include public service announcements, free or subsidized mammograms, and informational sessions designed to encourage early detection and preventative measures.

A notable finding in the results is that google trends of breast cancer search volume in Saudi Arabia has greatly increased specially in October, which is the Breast Cancer Awareness Month (BCAM). This trend aligns with global observations that awareness campaigns significantly boost public interest and engagement. However, the peaks in popularity in 2020-2021 of search relating to breast cancer has decreased due to a combination of global events following the COVID-19 timeframe. While we did not directly measure differences in BCAM efforts pre- and post-pandemic, this decline is likely attributable to shifts in public health priorities and limited participation in awareness activities due to restrictions and social distancing measures. It is important to note that public health campaigns during this period may have faced challenges in maintaining their usual level of outreach and visibility. Slight increase in the peak of the Google Trends index for breast cancer interest in 2022 suggests a normalization of health-seeking behaviors, possibly due to the easing of pandemic-

related restrictions. These findings are consistent with prior studies linking digital search trends to shifts in public behavior during global events.

Interestingly, the searches interest for "mammo-gram" exhibited sporadic peaks throughout the year with no clear pattern even in the pandemic period. This inconsistency suggests gaps in public knowledge about mammogram accessibility and its role in early breast cancer detection. This inconsistency suggests gaps in public knowledge about mammogram accessibility and its role in early breast cancer detection. Previous studies emphasize that such disparities are often linked to insufficient health education and regional inequalities. These results underscore the need to strengthen educational initiatives that promote mammography as a vital diagnostic tool, particularly in regions with low search interest. Overall, the results of mammogram are supporting evidence on the effectiveness of the BCAM in the last ten years.

Several studies appear to support the idea that searches are rational to predict collective actions in real life.<sup>21</sup> Since Internet access is still somehow restricted to Saudi's major cities and so limits the applicability of Google Trends there, regional analysis revealed significant variation in search trends across Saudi Arabia's 13 regions. Clearly, the interest search using "breast cancer" term is higher than "mammo-gram" term in Riyadh, Almadinah and Aseer regions may be due to the lack of enough knowledge related to the mammogram even though Riyadh region is known as the most developed region. The Eastern and Makkah regions showed an equal high rate of interest search of "breast cancer" and "mammo-gram," terms which could be associated with higher community awareness of breast cancer. Interestingly, other Saudi's regions showed low interest in both terms. These disparities are likely influenced by factors such as education levels, cultural beliefs, and urbanization, consistent with prior research on health-seeking behaviors in Saudi Arabia. Regions with a higher number of searches for "breast cancer" or "mammo-gram" are likely to have a higher rate of people affected by the condition, reflecting illness

burden.<sup>22-25</sup>

Our findings highlight several actionable opportunities for improving breast cancer awareness and early detection in Saudi Arabia: 1. Awareness campaigns should focus on underserved areas with low search interest for "mammogram" or "breast cancer." These gaps might be closed with the support of customized programs that address regional cultural and educational obstacles. 2. Campaigns should emphasize the accessibility to diagnostic tools and the importance of mammograms, particularly in regions with inconsistent search patterns. Mobile screening units and subsidized mammography services may improve accessibility. 3. Health authorities could utilize digital campaigns to sustain public interest throughout the year. Collaborations with influencers and localized content could further amplify outreach efforts. 4. Public health officials can evaluate the success of awareness campaigns and make real-time strategy adjustments by routinely examining search trends with tools like Google Trends.

## CONCLUSION

Our findings suggest that Saudi Arabia still requires several awareness campaigns especially in the country sides. It is beyond the scope of this study to suggest how we can increase the breast cancer awareness in different ways to ensure that every person in the society has the clear and the correct knowledge about this matter. These findings support the earlier statement on the necessity for rising awareness to reach all population in the Kingdom. It will increase positive interest in breast cancer, the importance for early diagnosis for a better survival among Saudi breast cancer patients.

### Abbreviations:

BCAM: Breast cancer awareness month  
SCR: Saudi Cancer Registry  
GT: Google Trends  
RSV: Relative search volume  
IRB: Institutional review board

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**Availability of data and materials:** The data and materials used are included within the article and is available upon request.

**Ethics approval and consent to participate:** The study was approved by the institutional review board (IRB) of King Abdullah International Medical Research Center.

**Transparency Declaration:** The primary author confirms that this manuscript provides a truthful, accurate, and transparent account of the study being presented. No important elements of the study have been excluded.

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