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Analysis of Google Trends reflecting interest of Internet users in topics related to breast cancer and its prevention in Poland, 2013–2023

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Abstract

Introduction and Objective. Breast cancer is the most commonly diagnosed cancer in women, both in Poland and globally. Despite the increasing incidence of breast cancer and the increase in research on Google Trends, there is little research on the application of this tool regarding oncology topics using key words in Polish. There is also a lack of research that focuses explicitly on breast cancer and prevention key words, which creates a need to fill this gap. The aim of the study is to analyse trends in Internet user interest in breast cancer and prevention in Poland between 2013–2023, based on the Google Trends tool.

Materials and Method. An analysis of search terms used by Polish Internet users for topics related to breast cancer and prevention in 2013–2023, using the Google Trends tool.

Results. Significant changes in the interest of Polish Internet users in selected issues related to breast cancer and its prevention in Poland between 2013 and 2023 were demonstrated. A clear decrease in interest in the key words was noted in the initial period of the COVID-19 pandemic.

Conclusions. A clear upward trend was shown between 2013–2023 in Poland in interest in the key words: 'mammography', 'breast ultrasound', 'breast examination', 'MRI', and 'breast biopsy'. The lowest interest for 9 of the 14 key words was recorded in April 2020 at the start of the COVID-19 pandemic. For 7 of the 14 key words, the highest interest (100 on the GT scale) was recorded in the month of October. Google Trends can be used to track public interest in breast cancer and screening in real time.

Key words

breast cancer, mammography, breast self-examination, breast cancer prevention, Google Trends

INTRODUCTION

Cancers of the breast gland are the most common oncological lesions in women worldwide [1], and the incidence of breast cancer is expected to increase in the coming decades due to an ageing population and population growth [2]. In Poland, the risk of breast cancer is estimated to be high, and the incidence of malignant tumours of the mammary gland has increased more than twofold over the past three decades [3]. Aggregate data from 16 provinces show that, in addition to the increasing overall number of new cases in the country, the increasing rate of incidence in ever younger women is of great concern [3, 4]. In 2020–2030, the National Oncology Strategy was introduced in Poland in an effort to reverse this worrying trend, with which great importance attributed to prevention and health education [5, 6]. In 2023, as part of the breast cancer prevention programme, changes were introduced to include women in a wider age range (women aged 45–74 can benefit from free mammography). The changes came into effect on 1 November 2023.

As of November 2023, Google has established itself as the leading search engine with an impressive market share of 71.61% [7]. One of Google's fascinating features is the free Google Trends (GT) tool, which shows what people are searching for on Google. GT provides data on the relative popularity of searches for any query, in any language, by time and region [8]. Analysis of web search trends is becoming a valuable resource for advertisers, economists, researchers, and anyone wanting to understand what interests Internet users [9, 10].

The aim of the study is to analyse trends in Internet user interest in breast cancer and prevention in Poland between 2013–2023, based on the Google Trends tool.

MATERIALS AND METHOD

The study analysed selected Internet search terms typed in Polish on topics related to breast cancer and prevention. The analysis covered the period from 1 October 2013 – 31 October 2023, with particular focus on the initial period of Pandemic COVID-19 falling in the months March-June 2020. Google Trends, which provides information on the number, origin, temporal dynamics and main regions of queries directed to the Google search engine, was used for the study. Key words were sorted exclusively in the Polish language and by country – Poland.

The key words analysed were selected in a multi-stage

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process. First, they were selected by brainstorming, taking into account phrases that were popular in the given topic. Next, key words from related topics were checked with other researchers in GT to exclude potentially missed important key words. Additionally, the 'Similar topics' section was checked during the analysis in GT to discover other popular searches. Passwords with too few searches were excluded. The full list of key words is shown below.

All passwords pre-screened GT	Headwords for which the number of searches reached the threshold in the analysed period	Key words with too few searches in the period analysed
Breast cancer	Breast cancer	Tumours of the mammary gland
Lump in the breast	Lump in the breast	Breast cancer screening
Tumours of the mammary gland	Symptoms of breast cancer	Breast palpation
Symptoms of breast cancer	Breast cancer prevention	Breast examination during pregnancy
Prevention of breast cancer during pregnancy	Breast examination	Prevention of breast cancer during pregnancy
Breast examination	Mammography	Breast examination and breastfeeding
Breast palpation	Breast ultrasound	Breast examination and lactation
Breast examination during pregnancy	Breast self-examination	3D mammography
Breast examination and breastfeeding	Breast MRI	When to examine breasts
Breast examination and lactation	Mastectomy	
Breast cancer prevention	BRCA1	
Mammography	Breast biopsy	
3D mammography	Breast cancer in men	
Breast ultrasound	Breast cancer treatment	
Breast self-examination		
Breast cancer screening		
When to examine breasts		
Breast MRI		
Mastectomy		
BRCA1		
Breast biopsy		
Breast cancer in men		
Breast cancer treatment		

The research was undertaken 1–2 November 2013 and 1–2nd November 2023. Approval was granted by the Bioethics Committee of the University of Rzeszów (No. 3/04/2021). Online search trends were analyzed as follows: initial date was provided by Google Trends, and the search interest measured on a scale from 0–100, with 100 representing the peak popularity; the focus on trends and spikes in search volume within the 0–100 range. To understand how search patterns changed over time for each key word, a linear trend was calculated. Relationships between different key words were explored using Spearman's rank correlation. Additionally, calculations were performed to assess the overall strength of the linear trends.

RESULTS

The research showed a clear upward trend between 2013–2023 for the key words: 'mammography' – $R^2 = 0.8793$; 'breast ultrasound' – $R^2 = 0.9312$; 'breast examination' – $R^2 = 0.6704$; 'MRI' – $R^2 = 0.6499$; and 'breast biopsy' – $R^2 = 0.517$ (Fig. 1).

No upward trend was shown for the remaining key words: 'breast cancer' – $R^2 = 0.0375$; 'breast lump' – $R^2 = 0.0368$; 'breast cancer symptoms' – $R^2 = 0.0183$; 'breast cancer prevention' – $R^2 = 0.0003$; 'breast self-examination' – $R^2 = 0.0589$; 'mastectomy' – $R^2 = 0.0457$; 'BRCA1' – $R^2 = 0.2254$; 'breast cancer in men' – $R^2 = 0.0005$; and 'breast cancer treatment' $R^2 = 0.0006$ (Fig. 2–3).

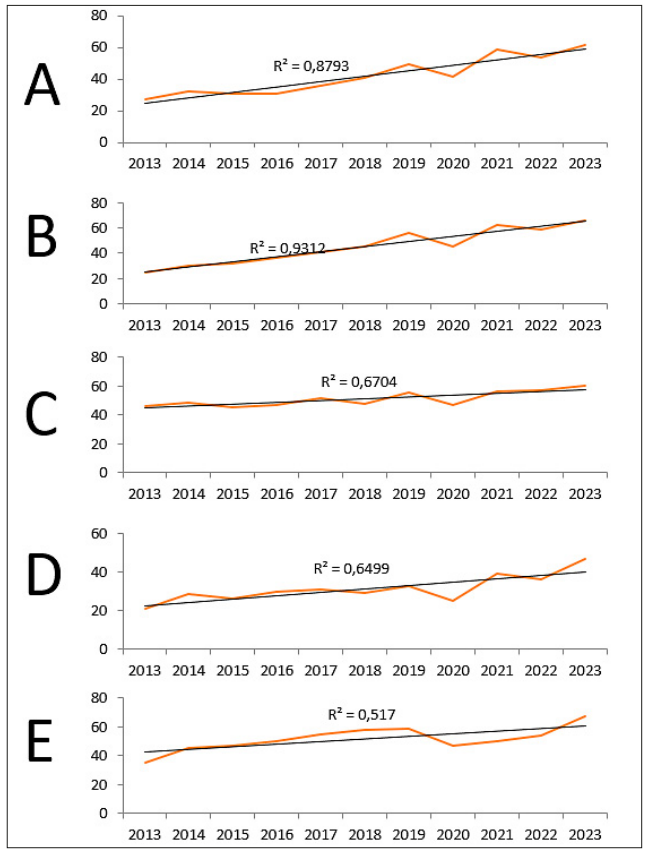

Figure 1. Linear trend for time interval 2013–2023 key words: A – 'mammography', B – 'breast ultrasound', C- 'breast examination', D – 'breast MRI', E- 'breast biopsy'

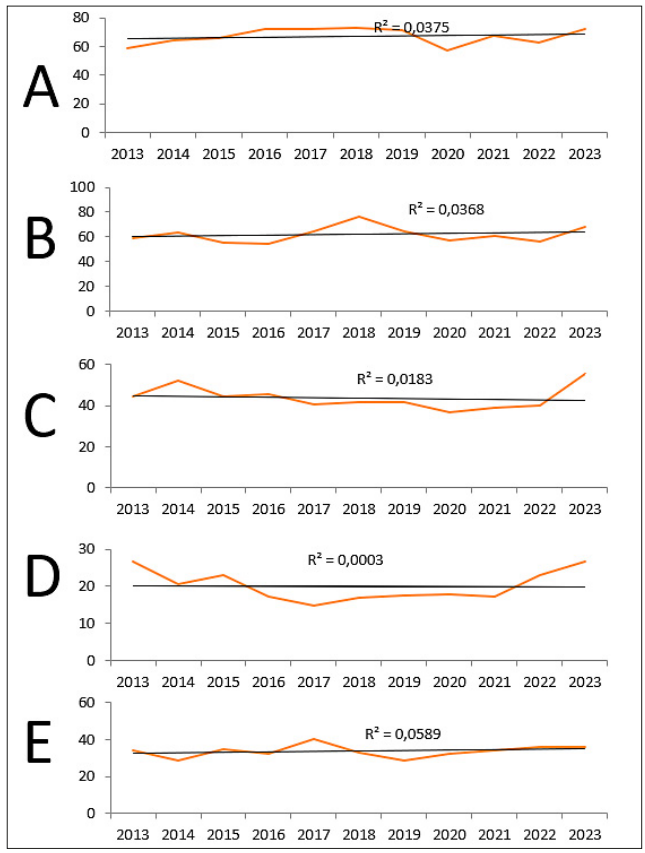

Figure 2. Linear trend for time interval 2013–2023 key words: A – 'breast cancer', B – 'breast lump', C – 'breast cancer symptoms', D – 'breast cancer prevention', E – 'breast self-examination'

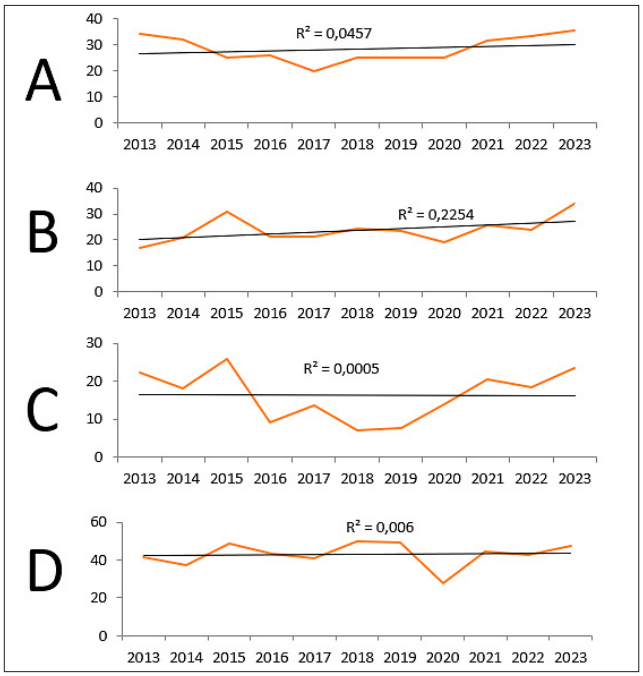

Figure 3. Linear trend for time interval 2013–2023 key words: A – 'mastectomy', B – 'BRCA1', C – 'male breast cancer', D – 'breast cancer treatment'

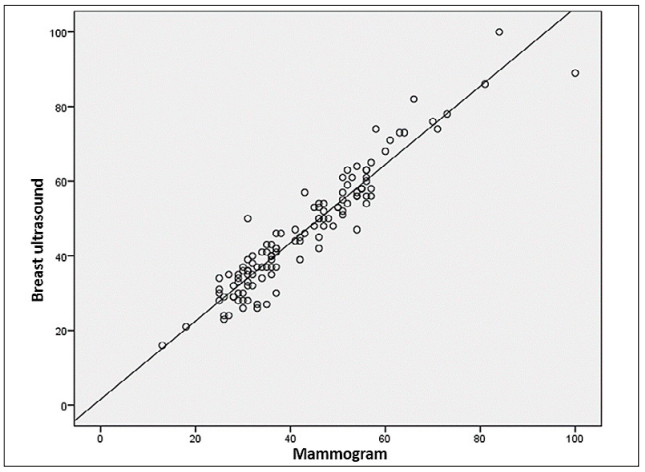

Figure 5. Spread for key words 'mammography' and 'breast ultrasound'

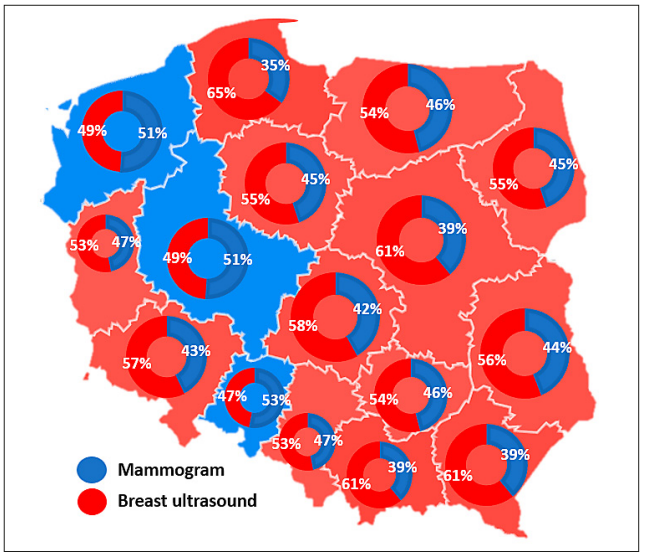

Figure 6. Breakdown by province – comparison of the average interest of Internet users in the key words 'breast ultrasound' and 'mammography' between 2013–2023. *Source:* own compilation based on Google Trends

The key words of greatest interest were: 'mammography' and 'breast ultrasound'. Interestingly, these key words showed a similarity in the time trend between 2013–2023. The biggest drop in interest for both key words was seen in April 2020 – at the beginning of the COVID 19 Epidemic (Fig. 4). There was a statistically significant correlation between these key words (Spearman's rank correlation coefficient R=0.940; p<0.0001) – which means that whoever selected one key word was also looking for the other key word. This clearly shown in the scatter plot (Fig. 5).

Analysis of the interest of Internet users in Poland by province showed interest in the key word 'breast ultrasound' in 13 of 16 provinces. The key word 'mammography' was more popular only in the Zachodniopomorskie, Wielkopolskie and Opolskie provinces. The greatest difference in interest in the key words 'breast ultrasound' compared to the key word 'mammography' was noted in the Pomorskie Province: 'breast ultrasound' – 65%, 'mammography' – 35%. (Fig. 6).

It was shown that for nine of the 14 key words analysed, the lowest interest was recorded in April 2020 for 'breast cancer' – 46 on the GT scale, 'breast cancer prevention' – 0 on the GT scale, 'breast examination' – 17 on the GT scale, 'mammography' – 14 on the GT scale, 'breast ultrasound' – 16 on the GT scale, 'breast MRI' – 0 on the GT scale, 'mastectomy' – 13 on the GT scale, 'BRCA1' – 10 on the GT scale, and 'breast cancer in men' – 0 on the GT scale.

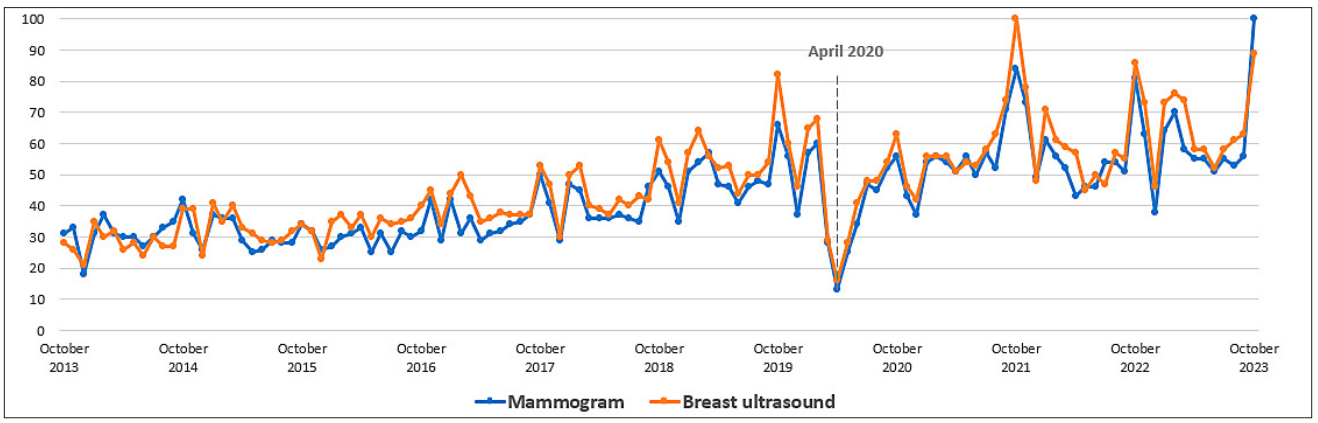

Figure 4. Internet user interest in key words: 'breast ultrasound' and 'mammography' between 2013–2023.
Source: Google Trends

It was also shown that for seven of the 14 key words, the highest interest (100 on the GT scale) was recorded in the month of October in different years: 'breast cancer', 'breast lump', 'breast cancer prevention', 'breast examination', 'mammography', 'breast ultrasound', and 'breast biopsy'. Analysis was also made of whether the number of searches for selected phrases differed before the COVID-19 pandemic was announced, and in its first months. The analysis was conducted in two stages: two time periods were distinguished: before the COVID-19 pandemic and during the first months of the pandemic. The number of searches for each key word in both periods was compared, using the chi-square test. Results were considered statistically significant if the p-value was less than 0.05 (Tab. 1).

The research showed that the key words 'breast cancer' attained the highest popularity in the Świętokrzyskie Province (GT=100), and the lowest in the Lubuskie Province (GT=81). The highest interest in the key words slogans 'lump in the breast', 'breast cancer symptoms', and 'breast cancer prevention' (GT=100) was recorded in the Wielkopolska Province. The highest popularity of the key word 'mammography' (GT=100) was recorded in two provinces: Opolskie and Wielkopolskie. The Opole Province was also in first place in terms of popularity for the search term 'breast examination'. The highest number of queries related to the key word 'breast ultrasound' was found in the Małopolska Province (GT=100).

On the other hand, the Mazovian Province achieved the highest score in the number of searches for the key words 'breast self-examination', 'breast MRI' and 'breast cancer treatment'. The key words 'breast biopsy' were the most popular in the Kujawsko-Pomorskie Province (GT=100). The highest interest in the key words 'mastectomy' and 'BRCA1' was recorded in the West Pomeranian Province (GT=100).

In the case of some key words, the value 0 was obtained in individual provinces, which means a location in which there was insufficient data for the keyword (Tab.2). The study also showed that the Mazowieckie Province demonstrated the largest number of Internet user queries on the analysed key words – data on 13 out of 14 keywords, followed by the Wielkopolskie Province – data on 10 out of 14 key words. The least amount of data was obtained from the Lubuskie Province – five out of 14 key words, while the Wielkopolskie province obtained the highest number – four key words (100 on the GT scale).

DISCUSSION

Google Trends (GT) is a Google service that uses publicly available data to render research transparent and easily reproducible. It draws information from the searches of hundreds of millions of internet users, giving researchers

Table 1. List of terms and peak values of interest according to Google Trends for individual key words.

Key words	INTEREST IN KEY WORDS				
	Greatest interest		Least interest		
	Date	GT scale	Date	GT scale	
Breast cancer	**October 2014**	100	**April 2020**	46	X^2 =19.973; p=1; p<0.0001 (0.00000786)
Lump in the breast	**October 2014**	100	July 2016	21	X^2 =50.284; df=1; p<0.0001
Symptoms of breast cancer	November 2014	100	September 2018	6	X^2 =83.358; df=1; p<0.0001
Breast cancer prevention	**October 2023**	100	May 2014, July-August 2014, July 2015, September 2015, December 2015, January 2016, March 2016, May 2016, July-September 2016, April 2017, July 2017, March 2018, July 2018, September 2018, November 2018, July 2019, November 2019, April-May **2020,** July- 2020,August 2021,May 2022, August 2022	0	X^2 =100.00; df=1; p<0.0001
Breast examination	**October 2022**	100	**April 2020**	17	X^2 =57.474; df=1; p<0.0001
Mammography	**October 2023**	100	**April 2020**	14	X^2 =64.877; df=11; p<0.0001
Breast ultrasound	**October 2021**	100	**April 2020**	16	X^2 =60.823; df=1; p<0.0001
Breast self-examination	January 2015	100	October 2013-August-September 2014, August 2015, December 2015, July 2016, August 2022	0	X^2 =100.00; df=1; p<0,0001
Breast MRI	March 2014	100	June 2014, October 2014, October 2016, September 2018, **April 2020**	0	X^2 =100.00; df=1; p<0,0001
Mastectomy	December 2014	100	**April 2020**	13	X^2 =65.456; df=1; p<0.0001
BRCA1	March 2015	100	**April 2020**	10	X^2 =73.636; df=1; p<0,0001
Breast biopsy	**October 2023**	100	April 2016	18	X^2 =56.983; df=1; p<0,0001
Breast cancer in men	September 2015	100	November 2013, January-February 2014, April-September 2014, March 2015, July-August 2015, December 2015, March-April 2016, June-August 2016, October-December 2016, February-March 2017, May-July 2017, September-October 2017,June 2018, January-February 2018, June 2018-January 2019, March-May 2019, July-August 2019, November-December 2019, March-April **2020, September-October 2020, December 2020,** February 2021, April 2021, July 2021, September 2021, November 2021, January 2022, May-June 2022, August 2022, February 2023, April 2023, September 2023	0	X^2 =100.00; df=1; p<0,0001
Breast cancer treatment	April 2019 May 2021	100	January-February 2014, July 2014, February 2015, October 2016 July 2017, September-October 2020, April 2021	0	X^2 =100.00; df=1; p<0,0001

GT – Google Trends; p – statistical significance; χ^2 – test statistic; df – degrees of freedom

access to an unprecedented amount of data. The data is updated in real time, enabling rapid analysis of trends and internet user behaviour [11]. GT provides objective information [12]. The advantages of GT are making it an increasingly popular tool in health research, particularly public health issues [13, 14]. GT allows the tracking of trends in Internet searches, which provides valuable information about what interests Internet users and the issues of concern to them.

GT is playing an increasingly important role in cancer research, with the first study using GT being published in 2013, since when the number of publications has steadily increased. One study analysed 85 scientific articles by using GT to analyse Google searches related to malignant tumours. Among the publications analysed, the largest number were related to breast cancer, as many as 22% (19/85) were related to prevention issues, 20% (17/85) to awareness events, 11% (9/85) linked cancer topics to celebrities, 13% (11/85) were related to COVID-19, and 47% (40/85) belonged to other categories [15].

One of the main problems in oncology is the increase in breast cancer both in Poland and worldwide. In Peru, for example, time trend analyses of the last five years of interest in the most common cancers showed breast cancer to be the topic with the highest search rate (median: 20, range: 6–100) [16]. Breast cancer is the most common malignancy in women [4]. The current study confirms the interest of the public in the key word "breast cancer", but did not show an upward trend in this area (R^2 =0.0375). Knowledge of the symptoms of breast cancer is crucial in order to implement early diagnosis, but own research has shown that in Poland there is little interest in breast cancer prevention (R^2 =0.0003) and breast cancer symptoms (R^2 =0.0183). Similar results were obtained using GT in a study in Malaysia (2007–2018) of the public search pattern for information about breast cancer screening and breast cancer-related search terms. The study showed a decreasing trend in breast cancer search terms, while those for mammography screening fluctuated steadily? fluctuated / steadily increased [17].

Own research showed a clear upward trend between 2013–2023 in terms of Internet users' interest in the key words: 'mammography' – R^2 = 0.8793; 'breast ultrasound' – R^2 = 0.9312; 'breast examination' – R^2 = 0.6704; 'MRI' – R^2 = 0.6499; and 'breast biopsy' – R^2 = 0.517. Interestingly, the key words 'mammography' and 'breast ultrasound' were are among the most frequently selected by Internet users on the topic of breast cancer, which is confirmed by own research as well as that of other authors [18–20]. Moreover, own research for these key words showed a similarity in the time trend between 2013–2023. For both key words, the greatest decrease in interest was observed in April 2020 – at the beginning of the COVID-19 pandemic. There is also a statistically significant correlation between these key words (Spearman's rank correlation coefficient R=0.940; p<0.0001).

Lack of access to screening tests, such as mammography, breast ultrasound and difficulties in performing biopsies, result in the late detection of cancer, and has a huge impact on survival rates and treatment costs. The COVID-19 pandemic led to delays in cancer diagnosis due to deferred testing; additionally, during the initial phase of the pandemic, the interest of Internet users focused mainly on COVID-19 issues, resulting in a decline in interest in other disease entities. Own research showed that interest in most of the key words decreased sharply at the beginning of the COVID-19 pandemic, and then increased again after a short period of decline of about two or three. For nine of the 14 slogans analysed, the lowest interest in the time frame analysed was in April 2020: 'breast cancer', 'breast cancer prevention', 'breast examination', "mammography', 'breast ultrasound', 'breast MRI', 'mastectomy', 'BRCA1', and 'breast cancer in men'. Similar trends have been observed by other researchers. For example, Snyder et al. showed that searches for phrases related to cancer screening (e.g. 'colonoscopy', 'mammography', 'lung cancer screening' and 'cytology smear') dropped by 76% during the first peak of the COVID-19 pandemic, compared to the pre-pandemic period [18]. A study by Greiner et al. found that interest in cancer screening in the USA decreased sharply at the start of the COVID-19 pandemic. According to Google Trends, searches for the key word 'mammography' by US Internet users dropped sharply and then slowly increased, returning to pre-pandemic levels at the end of May 2020 [21]. The same results were obtained in several other studies which showed that, despite an initial drastic decline in interest in mammography between March-April 2020, there was an increase in interest in performing mammograms in later months [19, 22, 23].

For many years, October has been recognised worldwide as Breast Cancer Awareness Month, with Evelyn Lauder (co-founder of the Estée Lauder cosmetics company) the originator of the Pink October campaign, after in 1992 she introduced the pink ribbon as a symbol of the fight against breast cancer. She encouraged people to wear it as an expression of support for cancer sufferers and to promote prevention. Such health campaigns are effective in mobilising public awareness about breast cancer [24].

The current study shows that for seven of the 14 key words, the peak of interest (100 on the GT scale) was recorded in the month of October in different years – 'breast cancer', 'breast lump', 'breast cancer prevention', 'breast examination', 'mammography', 'breast ultrasound', and 'breast biopsy'. Many other studies have shown correlations between Internet users' breast cancer search activity and Breast Cancer Awareness Month in October [19, 22]. An analysis of interest in the Brazilian public. showed a seasonal interest in the key word 'breast cancer' in October from 2014–2019 [24]. A study by Vasconcellos-Silva et al. in Brazil analysed public interest in mammography and breast cancer over a 261-week period – November 2011-October 2016. The results showed a continuous increase in interest in both topics over the five years. The growth trends for both phrases were almost identical. Unusual peaks were observed in October, with interest in the key word 'mammography' increasing by 119.1% (2016) above the annual average, respectively [20]. Analyses of Internet user interest in Peru showed a cyclical, point increase in interest in breast cancer key words in the month of October. The study also found a positive temporal correlation between Internet users' interest in particular key words and breast cancer awareness campaigns [16]. A study in Malaysia found a strong correlation between public interest in breast cancer screening and the Pink October breast cancer awareness campaign. [17]. Similarly, in the Colbourne et.al. study, Google Trends analysis showed that searches increased by 49% in October between January 2010-December 2021. The average relative number of searches for breast cancer per campaign month was 72.6 [25].

Google Trends analysis has great potential, but it also has limitations: there is a potential over-representation of younger, more tech-savvy Internet users who actively search for health-related terms. Secondly, Google Trends data may not represent parts of the population that do not have access to the Internet, for example in countries lacking infrastructure and technology or with lower socio-economic status. Thirdly, Google Trends data only relates to Internet users using Google's search engine.

In Poland, Google Trends can be a valuable tool for assessing public interest in cancer and cancer screening. This allows accurate decisions to be made to improve breast cancer screening rates in the future. The use of Google Trends in this context is gaining popularity. A similar view is expressed by Cohen et al. [22] and Greiner et al., who indicate that this tool can be used as an indicator of people's cancer screening behaviour, particularly for colorectal and breast cancer screening. The continuation of the negative trend in cancer screening may lead to widening socio-economic and racial disparities in cancer diagnosis, incidence and mortality [21].

In Poland, the identification of trends allows prioritisation of educational activities on breast cancer prevention. Google Trends can help identify areas with low rates of interest in breast cancer and screening topics, and this information can be used to target educational campaigns in these areas, which in the long term can lead to increased rates of screening and early detection of cancer. Google Trends can be used to assess the effect of awareness campaigns in Poland which will allow determination of whether campaigns are reaching their target audiences. With Google Trends, it is also possible to track changes in interest in breast cancer over the course of a campaign. This allows a more efficient use of resources and maximises the impact of educational campaigns.

CONCLUSIONS

- A clear upward trend was shown between 2013–2023 in Poland in interest in the key words: 'mammography', 'breast ultrasound', 'breast examination', 'MRI', and 'breast biopsy'.
- The lowest interest in nine of the 14 keywords was recorded in April 2020, at the start of the COVID-19 pandemic.
- For seven of the 14 key words, the highest interest (100 on the GT scale) was recorded in the month of October in different years: 'breast cancer', 'breast lump', 'breast cancer prevention', 'breast examination', 'mammography', 'breast ultrasound', and 'breast biopsy'.
- Google Trends can be used to track public interest in breast cancer and screening in real time.

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