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ORIGINAL ARTICLE SPECIAL TOPICS

Celebrity Influence Affecting Public Interest in Plastic Surgery Procedures: Google Trends Analysis

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Abstract

Background Medical decisions made by celebrities have a profound influence on medical decisions made by the general population. Google Trends (GT) is a free, online resource with virtually no barriers to use that allows for tracking of global search volumes as a proxy for determining public interest. In this study, we utilize GT to characterize the significant and measurable effects that the May 2013 announcement of Angelina Jolie's BRCA-influenced prophylactic mastectomy, May 2015 announcement of Kylie Jenner's lip augmentation, April 2017 announcement of Caitlyn Jenner's gender affirming surgery and February 2014 media attention given to Kim Kardashian's rumored buttock augmentation had on corresponding surgical procedure volumes.

Methods GT databases of search volumes were collected for terms related to prophylactic mastectomy, lip augmentation, gender affirming surgery and buttock augmentation categories from January 2004 to March 2019 using the "related queries" feature. Mean search volumes prior to respective announcements were compared to that of the period starting 6 months after. Additionally, the percent change from the month preceding respective celebrity announcements was compared to the month of the announcement for each search term.

Results For mastectomy, all terms demonstrated peak interest during May 2013. Following Jolie's announcement, interest in "mastectomy" rose 1328%, "prophylactic mastectomy" rose 324%, "BRCA1" rose 316%, "BRCA2" rose 138% and "BRCA gene" rose 354%. Long-term interest was higher after May 2013 than beforehand for all terms except "prophylactic mastectomy" (each, $p < 0.001$). Following Kylie Jenner's announcement, interest in "lip augmentation" rose 43%, "lip enhancement" rose 37%, "lip fillers" rose 3233%, "lip implants" rose 8% and "lip injections" rose 13%. Long-term interest was higher after May 2015 than beforehand for all terms except "lip augmentation" and "lip enhancement" (each, $p < 0.001$). Following Caitlyn Jenner's announcement, "gender affirming surgery" rose 119%, "gender reassignment" rose 186%, "gender reassignment surgery" rose 203% and "transgender surgery" rose 35%. Long-term interest was higher after April 2017 than beforehand for all terms except "sex change" (each, $p < 0.001$). Following Kardashian's rumored injections, interest in "butt enhancement" rose 34% and "butt implants" rose 100%. Long-term interest was higher after February 2014 than beforehand for all terms (each, $p < 0.001$).

Conclusions GT data trends correlate with shifts in real-world healthcare utilization and healthcare-related public interest caused by high-profile public events, making it a

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useful tool for real-time prediction of trends in public health in response to a variety of observable influences.
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Keywords Google trends · Public interest · Sex reassignment surgery · Prophylactic mastectomy · Celebrity

Introduction

Celebrity influence can affect many aspects of consumer product choice, including technology, fashion, aesthetics and health care. Medical decisions made by celebrities can have a profound influence on those made by the general population. A prime example of this is demonstrated by basketball player Earvin "Magic" Johnson's disclosure that he tested positive for HIV on November 7, 1991 [1]. In the ensuing weeks, US Centers for Disease Control and Prevention's National AIDS Hotline had a marked increase in individuals calling and seeking HIV/AIDS-related information [2]. In 2000, journalist Katie Couric campaigned to promote awareness for colon cancer. After she televised her own colonoscopy on the "Today Show," a study of the patients from 400 endoscopists noted the colonoscopy rate performed on women increased from 43.4 to 47.4% over the following 5 months [3]. Additionally, during the period from mid-2008 to mid-2009, in which British movie star Jane Goody was diagnosed and ultimately passed away from cervical cancer, England reported a roughly half-million increase in cervical screenings [4].

One of the most well-known examples of celebrity influence on surgical procedure volumes was American actress Angelina Jolie's prophylactic mastectomy announcement in the New York Times in May 2013 [5–7]. Massive media coverage by outlets such as Time and People Magazines, CNN and Fox News resulted in what is now termed the "Angelina Jolie Effect," or the concept that high-profile celebrity announcements can have major, persistent influences on elective healthcare decisions by the general population [5, 8, 9]. Specifically, the Angelina Jolie effect has been ascribed to the increased rates of BRCA1 and BRCA2 gene testing and risk-reducing prophylactic mastectomy (RRPM) around the period of Jolie's announcement and during the years following [10–12]. In more recent years, elective surgical procedures undergone by celebrities such as Caitlyn Jenner, Kylie Jenner and Kim Kardashian have, similarly, been the focus of intense media scrutiny.

With the advent of Google Trends (GT), a method of monitoring Internet search trends by analyzing the frequency of Google inquiries during a specified time period, a new method of collecting and characterizing data in the medical field has become widely available [13, 14]. Various studies have already demonstrated the utility of GT data for tracking infectious disease outbreaks, breast cancer screening practices and interest in plastic and reconstructive surgery procedures [15–22].

In this study, our primary goal was to further characterize Google Trends' ability to track public interest in surgical procedures. Our secondary goal was to examine whether the "celebrity effect" (which has been previously described in relation to Angelia Jolie's effect on mastectomy rates and BRCA testing) can be seen as a result of public announcements and popular culture events related to aesthetic and reconstructive surgery. Specifically, we examine the ability of GT to characterize the significant and measurable effect that the announcements of Angelina Jolie's RRPM, Caitlyn Jenner's gender affirming surgery, Kylie Jenner's lip augmentation, and Kim Kardashian's rumored buttocks augmentation had on related search terms in their respective timeframes.

Methods

Using customizable specifications, including search term, time period, location, category, and format of results, GT may produce databases and graphics describing the search volumes of search terms relative to peak search volume within the specified time period. The peak interest is assigned a value of 100% and other values are defined relative to this peak. GT data are available for searches beginning in January 2004.

Search terms relating to respective procedures were generated using researcher consensus and the "related queries" feature of GT. GT produced graphs of search volumes over time as well as maps of geographic interest in the USA and worldwide. GT databases of search volumes over time were collected from January 2004 to March 2019. To evaluate change in public interest in prophylactic mastectomies following Angelina Jolie's announcement, databases were generated for "BRCA1," "BRCA2," "BRCA gene," "mastectomy" and "prophylactic mastectomy."

This study tracks the effect of celebrity announcements on public interest in plastic surgery procedures broadly by monitoring GT search volumes for relevant procedures as affected by Kylie Jenner's lip augmentation, Kim Kardashian's rumored buttock augmentation, and Caitlyn Jenner's gender affirming surgery. These three highly publicized events were chosen by researcher consensus on

the basis of their range over several cosmetic areas and procedure types, and their similarity in magnitude of public response.

To evaluate change in public interest in lip augmentation following Kylie Jenner's announcement, databases were generated for "lip augmentation," "lip enhancement," "lip fillers," "lip implants" and "lip injections." To evaluate change in public interest in gender affirming surgery following Caitlyn Jenner's announcement, databases were generated for "gender affirming surgery," "gender reassignment," "gender reassignment surgery," "sex change" and "transgender surgery." To evaluate change in public interest in buttock augmentation following high levels of media attention surrounding Kim Kardashian's rumored buttock augmentation, databases were generated for "Brazilian butt lift," "butt enhancement," "butt implants," "butt injections" and "butt lift."

Analyses were conducted to determine both immediate- and long-term effects of celebrity announcements. To measure immediate effects, the percent change from the month preceding respective celebrity announcements compared to the month of the announcement was calculated for each search term. For the prophylactic mastectomy category, percent change was calculated comparing April 2013 to May 2013. For the lip augmentation category, percent change was calculated comparing April 2015 to May 2015. For the gender affirming surgery category, percent change was calculated comparing March 2017 to April 2017. For the buttock augmentation category, percent change was calculated comparing January 2014 to February 2014.

To reflect the long-term effects of celebrity announcements on public interest, the mean search volume prior to respective announcements was compared to that of the period following the announcement, starting 6 months after the announcement in order to isolate long-term effects from more immediate effects. For the prophylactic mastectomy category, mean search volume between January 2004 and May 2013 was compared with November 2013–March 2019. For the lip augmentation category, mean search volume between January 2004 and May 2015 was compared with November 2015–March 2019. For the gender affirming surgery category, mean search volume between January 2004 and April 2017 was compared with October 2017–March 2019. For the buttock augmentation category, mean search volume between January 2004 and February 2014 was compared with August 2014–March 2019. All statistical and trend analyses were performed using Microsoft Excel Version 15.21.1 (Redmond, WA, USA) and SAS Studio Version 3.8 (Cary, NC, USA).

Results

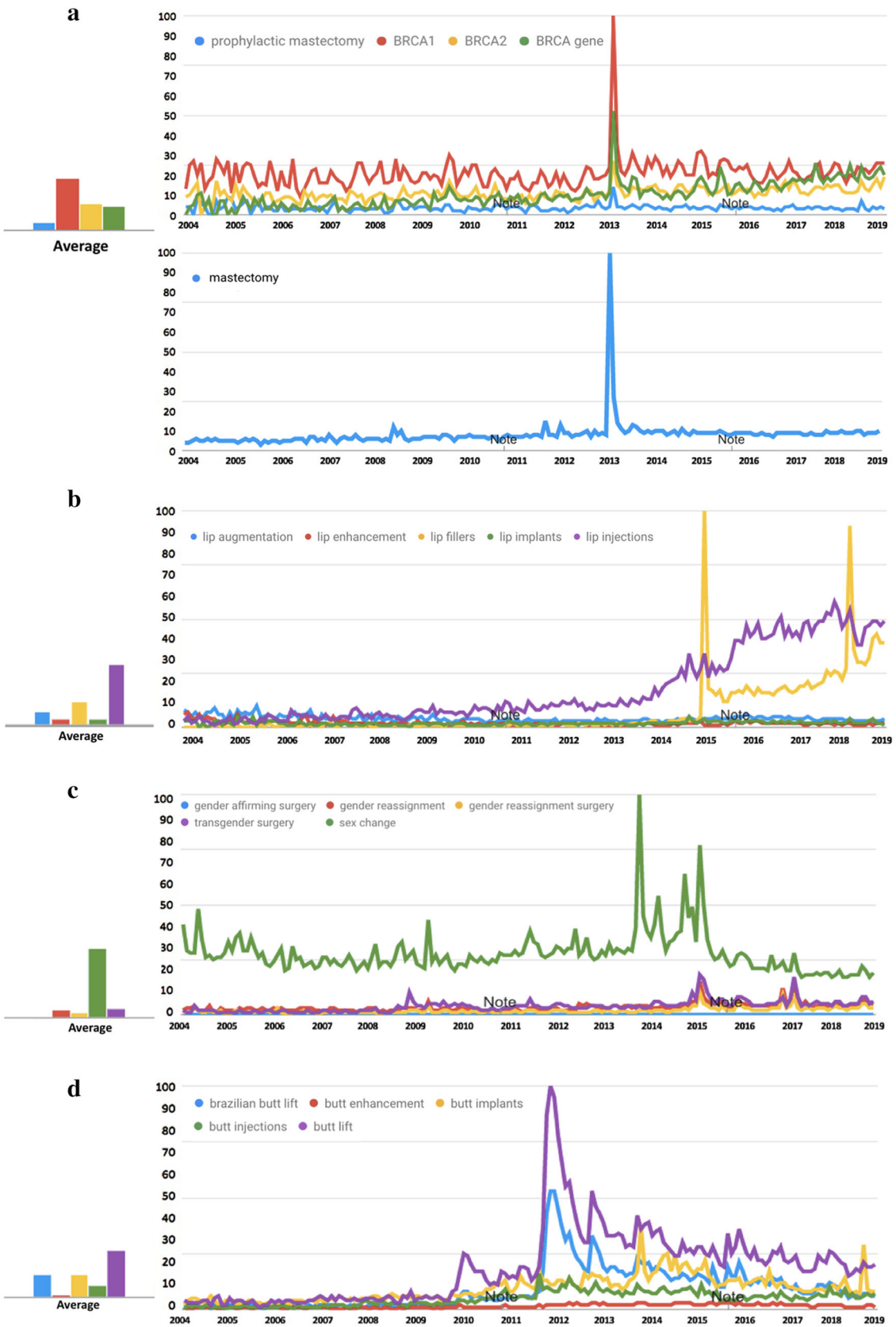
Celebrity Influence

For the prophylactic mastectomy category (Fig. 1a), all five search terms demonstrated peak interest (100%) during the month of May 2013, following Angelina Jolie's announcement that she had undergone a prophylactic double mastectomy in the same month. For the search term "mastectomy," interest increased from 7% in April 2013 to 100% in May 2013, a 1328% increase. For the search term "prophylactic mastectomy," interest increased from 22 to 100%, a 324% increase. For the term "BRCA1," interest increased from 24 to 100%, a 316% increase. For the term "BRCA2," interest increased from 42% to 100%, a 138% increase. Finally, for the term "BRCA gene," interest increased from 22 to 100%, a 354% increase.

For the lip augmentation category (Fig. 1b), interest in "lip augmentation" increased from 35% in April 2015 to 50% in May 2015, a 43% increase, following Kylie Jenner's lip announcement. For the search term "lip enhancement" interest decreased from 30 to 19%, a 37% decrease. For the term "lip fillers," interest increased from 3 to 100%, a 3233% increase. For the term "lip implants," interest increased from 72 to 78%, an 8% increase. Finally, for the term "lip injections," interest increased from 51 to 58%, a 13% increase.

For the gender affirmation surgery category (Fig. 1c), interest in "gender affirming surgery" increased from 16% in March 2017 to 35% in April 2017, a 119% increase, following Caitlyn Jenner's announcement. For the search term "gender reassignment," interest increased from 29 to 83%, a 186% increase. For the term "gender reassignment surgery," interest increased from 32 to 97%, a 203% increase. For the term "sex change," interest decreased from 44 to 48%, a 14% decrease. Finally, for the term "transgender surgery," interest increased from 31 to 59%, a 35% increase.

For the buttock augmentation category (Fig. 1d), interest in "Brazilian butt lift" decreased from 42% in January 2014 to 32% in February 2014, a 23% decrease, following Kim Kardashian's announcement. For the search term "butt enhancement," interest increased from 71 to 95%, a 34% increase. For the term "butt implants," interest increased from 50 to 100%, a 100% increase. For the term "butt injections," interest decreased from 63 to 58%, an 8% decrease. Finally, for the term "butt lift," interest decreased from 57 to 54%, a 5% decrease.


a
prophylactic mastectomy
BRCA1
BRCA2
BRCA gene
Note
Note
Average
mastectomy
Note
Note
b
lip augmentation
lip enhancement
lip fillers
lip implants
lip injections
Note
Note
Average
c
gender affirming surgery
gender reassignment
gender reassignment surgery
transgender surgery
sex change
Note
Note
Average
d
brazilian butt lift
butt enhancement
butt implants
butt injections
butt lift
Note
Note
Average
2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

◀**Fig. 1** **a** Temporal trends in public interest in mastectomy-related search terms. Worldwide trends in averaged monthly search volumes for mastectomy-related search terms from January 2004 to March 2019. Level of interest is expressed on a scale of 0 to 100%, with 100% interest reflecting the month with the highest search volume (Blue, Upper = "prophylactic mastectomy"; Red = "BRCA1"; Yellow = "BRCA2"; Green = "BRCA gene"; Blue, Lower = "mastectomy"). **b** Temporal trends in public interest in lip augmentation-related search terms. Worldwide trends in averaged monthly search volumes for mastectomy-related search terms from January 2004 to March 2019. Level of interest is expressed on a scale of 0% to 100%, with 100% interest reflecting the month with the highest search volume (Blue = "lip augmentation"; Red = "lip enhancement"; Yellow = "lip fillers"; Green = "lip implants"; Purple = "lip injections"). **c** Temporal trends in public interest in gender affirming surgery-related search terms. Worldwide trends in averaged monthly search volumes for mastectomy-related search terms from January 2004 to March 2019. Level of interest is expressed on a scale of 0% to 100%, with 100% interest reflecting the month with the highest search volume (Blue = "gender affirming surgery"; Red = "gender reassignment"; Yellow = "gender reassignment surgery"; Green = "sex change"; Purple = "transgender surgery"). **d** Temporal trends in public interest in the buttock augmentation-related search terms. Worldwide trends in averaged monthly search volumes for mastectomy-related search terms from January 2004 to March 2019. Level of interest is expressed on a scale of 0% to 100%, with 100% interest reflecting the month with the highest search volume (Blue = "brazilian butt lift"; Red = "butt enhancement"; Yellow = "butt implants"; Green = "butt injections"; Purple = "butt lift") [Data source: Google Trends (www.google.com/trends)]

Overall Popularity of Search Terms

Among the search terms analyzed in the prophylactic mastectomy category, "mastectomy" had the highest overall interest, followed by "BRCA1," "BRCA2," "BRCA gene" and "prophylactic mastectomy" (Fig. 1a). Among the search terms analyzed in the lip augmentation category, "lip injections" had the highest overall interest, followed by "lip fillers," "lip augmentation," "lip fillers" and "lip enhancement" (Fig. 1b). Among the search terms analyzed in the gender affirming surgery category, "sex change" had the highest overall interest, followed by "transgender surgery," "gender reassignment," "gender reassignment surgery" and "gender affirming surgery" (Fig. 1c). Among the search terms analyzed in the buttock augmentation category, "butt lift" had the highest overall interest, followed by "butt implants," "Brazilian butt lift," "butt injections" and "butt enhancement" (Fig. 1d).

Long-Term Effect on Public Interest

For the prophylactic mastectomy category (Fig. 2a), search volumes for all terms except "prophylactic mastectomy" were significantly higher in the period after Jolie's announcement, even while excluding data from the 6-month immediate post-announcement period. Pre- and post-announcement mean relative search volumes for each term were 6.4% and 9.0% for "mastectomy" ($p < 0.001$), 25.8% and 25.7% for "prophylactic mastectomy" ($p = 0.946$), 12.4% and 30.9% for "BRCA gene" ($p < 0.001$), 19.5% and 22.2% for "BRCA1" ($p < 0.001$), and 33.9% and 48.3% for "BRCA2" ($p < 0.001$).

For the lip augmentation category (Fig. 2b), search volumes for all terms except "lip augmentation" and "lip enhancement" were significantly higher in the period after Kylie Jenner's announcement. Pre- and post-announcement mean relative search volumes for each term were 43.2% and 43.1% for "lip augmentation" ($p = 0.987$), 28.7% and 22.3% for "lip enhancement" ($p < 0.001$), 1.0% and 24.0% for "lip fillers" ($p < 0.001$), 27.4% and 39.5% for "lip implants" ($p < 0.001$), and 15.3% and 80.0% for "lip injections" ($p < 0.001$).

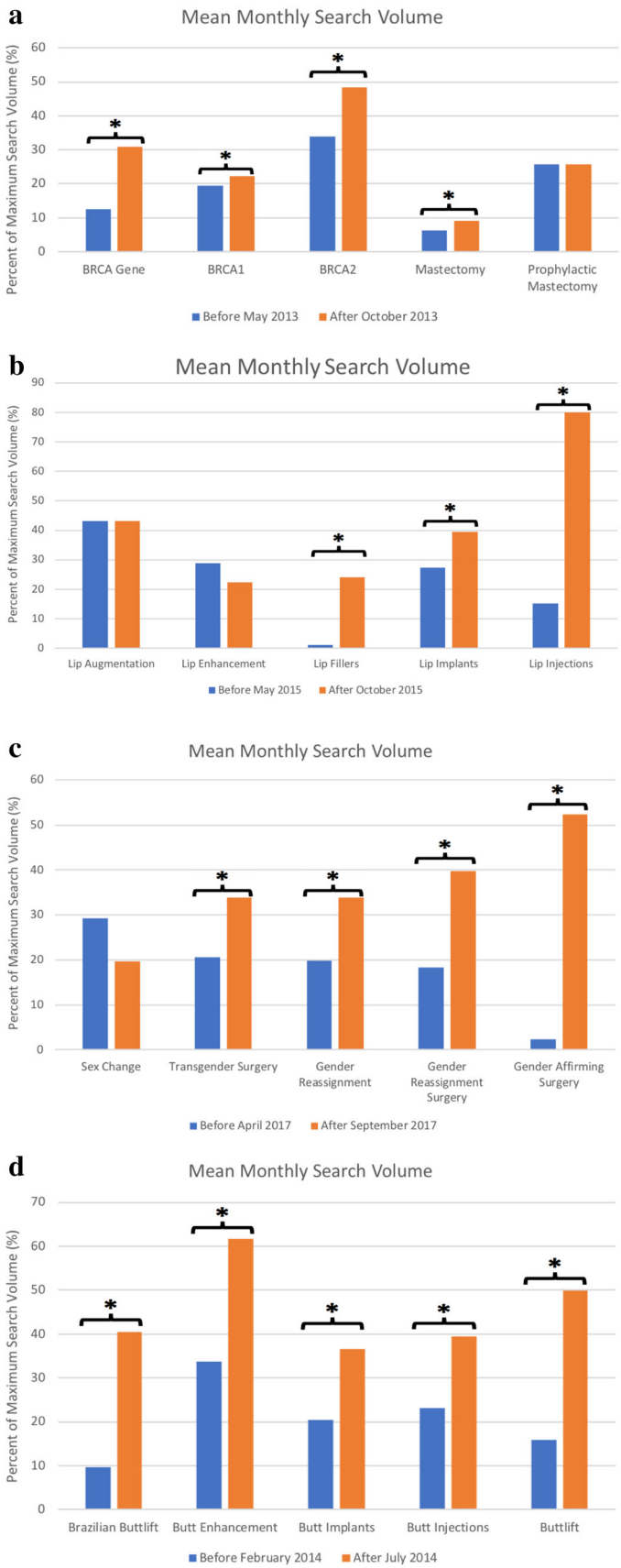
For the gender affirmation surgery category (Fig. 2c), search volumes for all terms were significantly higher in the period after Caitlyn Jenner's announcement pre- and post-announcement mean relative search volumes for each term were 0.9% and 39.1% for "gender affirming surgery" ($p < 0.001$), 17.4% and 32.4% for "gender reassignment" ($p < 0.001$), 15.4% and 36.6% for "gender reassignment surgery" ($p < 0.001$), 29.3% and 21.4% for "sex change" ($p < 0.001$) and 17.5% and 33.3% for "transgender surgery" ($p < 0.001$).

For the buttock augmentation category (Fig. 2d), search volumes for all terms evaluated were significantly higher in the period after significant speculation about Kim Kardashian's rumored buttock augmentation. Pre- and post-announcement mean relative search volumes for each term were 12.6% and 41.9% for "Brazilian butt lift" ($p < 0.001$), 37.6% and 58.4% for "butt enhancement" ($p < 0.001$), 24.6% and 31.0% for "butt implants" ($p < 0.001$), 26.3% and 35.8% for "butt injections" ($p < 0.001$), and 19.5% and 51.3% for "butt lift" ($p < 0.001$).

Interest in the USA by State

The country or region assigned 100% interest reflects that with the highest level of interest for a specific search term, and the other regions' assigned percentages reflect their interest relative to this peak. The five subregions with the highest level of interest for the search term which demonstrated the highest level of interest from January 2004 to March 2019 for each category are reported here.

For the prophylactic mastectomy category search term "mastectomy," Tennessee (100%) expressed the highest level of interest, followed by Connecticut (98%), Mississippi (94%), Maine (94%) and West Virginia (93%) (Fig. 3a). For the lip augmentation category search term "lip injections," Nevada (100%) expressed the highest


a
Mean Monthly Search Volume
Percent of Maximum Search Volume (%)
60
50
40
30
20
10
0
*
BRCA Gene
BRCA1
BRCA2
Mastectomy
Prophylactic Mastectomy
Before May 2013
After October 2013
b
Mean Monthly Search Volume
Percent of Maximum Search Volume (%)
90
80
70
60
50
40
30
20
10
0
Lip Augmentation
Lip Enhancement
Lip Fillers
Lip Implants
Lip Injections
Before May 2015
After October 2015
c
Mean Monthly Search Volume
Percent of Maximum Search Volume (%)
Sex Change
Transgender Surgery
Gender Reassignment
Gender Reassignment Surgery
Gender Affirming Surgery
Before April 2017
After September 2017
d
Mean Monthly Search Volume
Percent of Maximum Search Volume (%)
70
60
50
40
30
20
10
0
Brazilian Buttlift
Butt Enhancement
Butt Implants
Butt Injections
Buttlift
Before February 2014
After July 2014

◀**Fig. 2** **a** Lasting effect of Angelina Jolie's announcement on public interest. Mean total search volumes before and after May 2013. Mean relative search volumes are compared between the period before Jolie's announcement (January 2004–May 2013) to the period afterward (June 2014–March 2019), excluding data for the 6 months after Jolie's announcement (May 2013–October 2013). Search volumes for all terms except "prophylactic mastectomy" were significantly higher in the period after Jolie's announcement, even while excluding data from the 6-month immediate post-announcement period. Pre- and post-announcement mean relative search volumes for each term were 6.4% and 9.0% for "mastectomy" ($p < 0.001$), 25.8% and 25.7% for "prophylactic mastectomy" ($p = 0.946$), 12.4% and 30.9% for "BRCA gene" ($p < 0.001$), 19.5% and 22.2% for "BRCA1" ($p < 0.001$), and 33.9% and 48.3% for "BRCA2" ($p < 0.001$). *$p < 0.05$. **b** Lasting effect of Kylie Jenner's announcement on public interest. Mean total search volumes before and after May 2015. Mean relative search volumes are compared between the period before Jenner's announcement (January 2004–May 2015) to the period afterward (June 2015–March 2019), excluding data for the 6 months after Jenner's announcement (May 2015–October 2015). Search volumes for all terms except "lip augmentation" and "lip enhancement" were significantly higher in the period after Kylie Jenner's announcement. Pre- and post-announcement mean relative search volumes for each term were 43.2% and 43.1% for "lip augmentation" ($p = 0.987$), 28.7% and 22.3% for "lip enhancement" ($p < 0.001$), 1.0% and 24.0% for "lip fillers" ($p < 0.001$), 27.4% and 39.5% for "lip implants" ($p < 0.001$), and 15.3% and 80.0% for "lip injections" ($p < 0.001$). *$p < 0.05$. **c** Lasting effect of Caitlyn Jenner's announcement on public interest. Mean total search volumes before and after April 2017. Mean relative search volumes are compared between the period before Jenner's announcement (January 2004–April 2017) to the period afterward (May 2017–March 2019), excluding data for the 6 months after Jenner's announcement (April 2017–September 2017). Search volumes for all terms, except "sex change," were significantly higher in the period after Caitlyn Jenner's announcement pre- and post-announcement mean relative search volumes for each term were 0.9% and 39.1% for "gender affirming surgery" ($p < 0.001$), 17.4% and 32.4% for "gender reassignment" ($p < 0.001$), 15.4% and 36.6% for "gender reassignment surgery" ($p < 0.001$), 29.3% and 21.4% for "sex change" ($p < 0.001$), and 17.5% and 33.3% for "transgender surgery" ($p < 0.001$). *$p < 0.05$. **d** Lasting effect of Kim Kardashian's media attention on public interest. Mean total search volumes before and after February 2014. Mean relative search volumes are compared between the period before Kardashian's media attention (January 2004–February 2014) to the period afterward (March 2014–March 2019), excluding data for the 6 months after Kardashian's announcement (February 2014–July 2014). Search volumes for all terms evaluated were significantly higher in the period after significant speculation about Kim Kardashian's rumored buttock augmentation. Pre- and post-media attention mean relative search volumes for each term were 12.6% and 41.9% for "Brazilian butt lift" ($p < 0.001$), 37.6% and 58.4% for "butt enhancement" ($p < 0.001$), 24.6% and 31.0% for "butt implants" ($p < 0.001$), 26.3% and 35.8% for "butt injections" ($p < 0.001$), and 19.5% and 51.3% for "butt lift" ($p < 0.001$). Legend: *$p < 0.05$

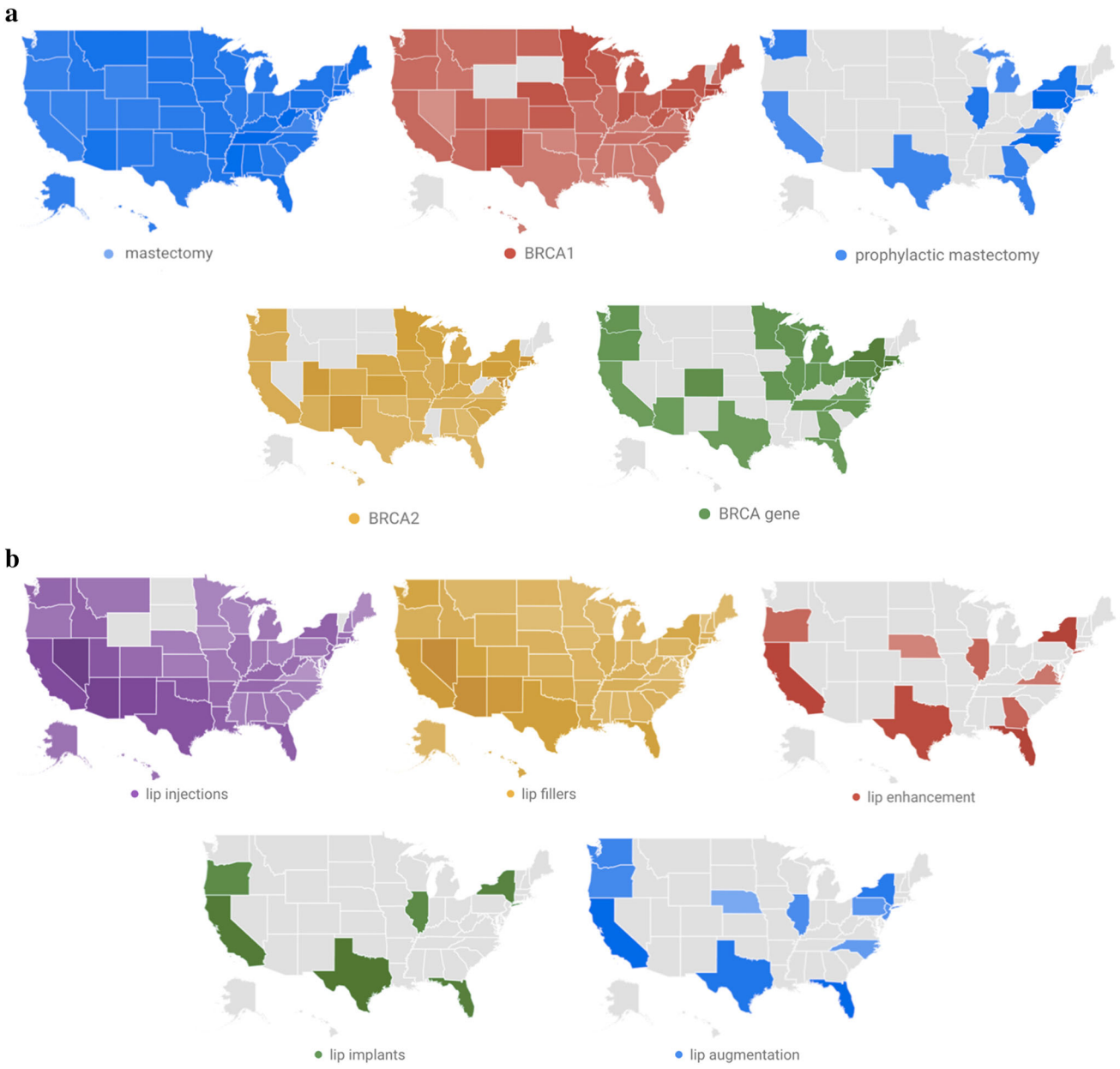
level of interest, followed by Arizona (91%), New Mexico (80%), California (78%) and Rhode Island (75%) (Fig. 3b). For the gender affirming surgery category search term "sex change," West Virginia (100%) expressed the highest level of interest, followed by Arkansas (99%), Kentucky (95%), Oklahoma (92%) and Mississippi (92%) (Fig. 3c). For the buttock augmentation category search term "butt lift," Florida (100%) expressed the highest level of interest, followed by Georgia (96%), Mississippi (92%), Nevada (91%) and Louisiana (90%) (Fig. 3d).

Discussion

Physicians and public health officials need accurate tools to help predict which high-profile celebrity announcements will likely affect public interest and utilization of healthcare resources. In this study, we have demonstrated one such tool in GT. We have shown that the "Angelina Jolie Effect," well-documented in popular media as well as medical literature, corresponded with immediate increased interest in GT search traffic related to BRCA genes and prophylactic mastectomy. Similarly, popular culture events such as Kylie Jenner's lip augmentation, Kim Kardashian's rumored butt implants, and Caitlyn Jenner's gender affirmation surgery correlated with markedly increased popularity of search terms related to these procedures (Fig. 1a–d). From April to May 2013, the time period measured before and immediately after Angelina Jolie's announcement, interest in mastectomy-related search terms ("mastectomy," "prophylactic mastectomy," "BRCA1," "BRCA2" and "BRCA gene") increased by between 138 and 354%. Similar short-term effects were seen for lip augmentation terms following Kylie Jenner's announcement, with the term "lip fillers" increasing by an impressive 3,233%. Most terms related to gender affirming surgery increased following Caitlyn Jenner's announcement, as well.

The increased search volume for each of these procedures was not limited to the immediate period after each respective celebrity event, but represented a significant and persistent increase in interest for the majority of search terms. For each event, comparing the pre-event period to the period starting 6 months following the event, eighteen out twenty of the relevant search terms had significantly higher search volumes (Fig. 2a–d). This suggests that the increased public interest in these terms was not just a transient sensation, but instead reflected an enduring increase in public awareness about these topics. Thus, public announcements like Jolie's and the Kardashian's family may have lasting changes on public interest in healthcare and cosmetic surgery.

Correlation with actual healthcare utilization suggests that GT may be useful in tracking important consequences of public announcements such as these. For example, increased internet search volume for mastectomy-related GT search terms around the time of Angelina Jolie's announcement coincides with actual rates of increased BRCA testing and RRPM. An analysis of MarketScan case


a
mastectomy
BRCA1
prophylactic mastectomy
BRCA2
BRCA gene
b
lip injections
lip fillers
lip enhancement
lip implants
lip augmentation

◀**Fig. 3** **a** Geographic trends in public interest in mastectomy-related search terms. US map illustrating the states with the highest GT search volumes for the search term which demonstrated the highest level of interest in the prophylactic mastectomy category. Level of interest is expressed on a scale of 0–100%, with 100% interest reflecting that that country or region had the highest level of interest in a given search term, and the other countries assigned percentages reflect their interest relative to the peak level. For the prophylactic mastectomy category search term "mastectomy", Tennessee (100%) expressed the highest level of interest, followed by Connecticut (98%), Mississippi (94%), Maine (94%) and West Virginia (93%). **b** Geographic trends in public interest lip augmentation-related search terms. US map illustrating the states with the highest GT search volumes for the search term which demonstrated the highest level of interest in the lip augmentation category. Level of interest is expressed on a scale of 0–100%, with 100% interest reflecting that that country or region had the highest level of interest in a given search term, and the other countries assigned percentages reflect their interest relative to the peak level. For the lip augmentation category search term "lip injections", Nevada (100%) expressed the highest level of interest, followed by Arizona (91%), New Mexico (80%), California (78%) and Rhode Island (75%). **c** Geographic trends in public interest in gender affirming surgery-related search terms. US map illustrating the states with the highest GT search volumes for the search term which demonstrated the highest level of interest in the gender affirming surgery category. Level of interest is expressed on a scale of 0% to 100%, with 100% interest reflecting that that country or region had the highest level of interest in a given search term, and the other countries assigned percentages reflect their interest relative to the peak level. For the gender affirming surgery category search term "sex change", West Virginia (100%) expressed the highest level of interest, followed by Arkansas (99%), Kentucky (95%), Oklahoma (92%) and Mississippi (92%). **d** Geographic trends in public interest in buttock augmentation-related search terms. US map illustrating the states with the highest GT search volumes for the search term which demonstrated the highest level of interest in the buttock augmentation category. Level of interest is expressed on a scale of 0–100%, with 100% interest reflecting that that country or region had the highest level of interest in a given search term, and the other countries assigned percentages reflect their interest relative to the peak level. For the buttock augmentation category search term "butt lift", Florida (100%) expressed the highest level of interest, followed by Georgia (96%), Mississippi (92%), Nevada (91%) and Louisiana (90%) [Data source: Google Trends (www.google.com/trends)]

volumes from 1997 to 2016 demonstrated an increased incidence rate for RRPM, from 0.2% before 2013 to 0.9% after 2013 [10]. This increase in RRPM rates is separate from increasing rates of prophylactic contralateral and prophylactic bilateral mastectomy in the past few decades, which do not appear to be directly influenced by Angelina Jolie's announcement [23, 24]. Rates of BRCA testing also increased by about 25% during the month of Jolie's announcement and persisted until at least 2017. GT tracks not only theoretical interest in procedures, but actual utilization of them.

A similar increase in actual case volumes can be seen for lip and buttock augmentation procedures, in correlation with their respective GT search volume increases. According to the American Society of Plastic Surgeons (ASPS) 2018 statistics report, between the years of 2000 to 2018, "buttock lift" procedures increased by 256%. According to American Society for Aesthetic Plastic Surgery (ASAPS) Statistics Reports, "buttock lift" procedures increased by 148% in the same period [24]. Similarly, ASPS reports a 66% increase in lip augmentation from 2000 to 2018 [25]. However, these trends should be interpreted with caution due to several limitations. Of note, ASPS and ASAPS databases only track case volumes reported by member surgeons. Also, many terms such as "buttock augmentation" were not recorded in 2000, precluding comparison, and terms related to gender affirming surgery have not been reported consistently at all. Previous characterization of the correlation of increased Google search traffic and US procedure volumes regarding breast-related, facial cosmetic and body-contouring cosmetic plastic surgery procedures has been conducted by Tijerina et al. [19–21].

Increased awareness and utilization are not necessarily always beneficial. Regarding cosmetic procedures, increased awareness could potentially exacerbate the frequency of body dysmorphia and lead them to seek unnecessary procedures [26, 27]. Downstream consequences of the "Angelina Jolie Effect" may be of even more relevance to public health. Many patients who sought consultation for BRCA testing and/or mastectomy as a result of Jolie's announcement had very poor understanding of what these interventions entailed. As a result, many patients may have sought unnecessary genetic testing. The aforementioned MarketScan analysis found no increase in rates of RRPM among the increased cohort of BRCA-tested patients that could be attributed to Angelina Jolie's announcement [10]. It might be inferred that many of the patients influenced by Jolie to get BRCA testing were actually normal-risk patients with no strong indications for BRCA testing. Patients may also misinterpret the results of tests they receive. While sources such as the National Cancer Institute and genetic testing information were significantly sought out by the public after Jolie's announcement, one study reported that less than 10% of patients reported having the information necessary to interpret the risk inherent to the BRCA gene mutation [28–30]. Provider awareness of such information asymmetry should be emphasized during these visits, especially when the high cost of unnecessary genetic testing is considered.

While the majority of search terms did have increased search volumes both in the short term and in the long term after their respective public announcements, some terms did not. There are a number of possible explanations for this, including that some terms like "sex change," which was not positively correlative, have fallen out of favor due to changes in political and medical terminology. Additionally, terms such as "butt lift," which was not

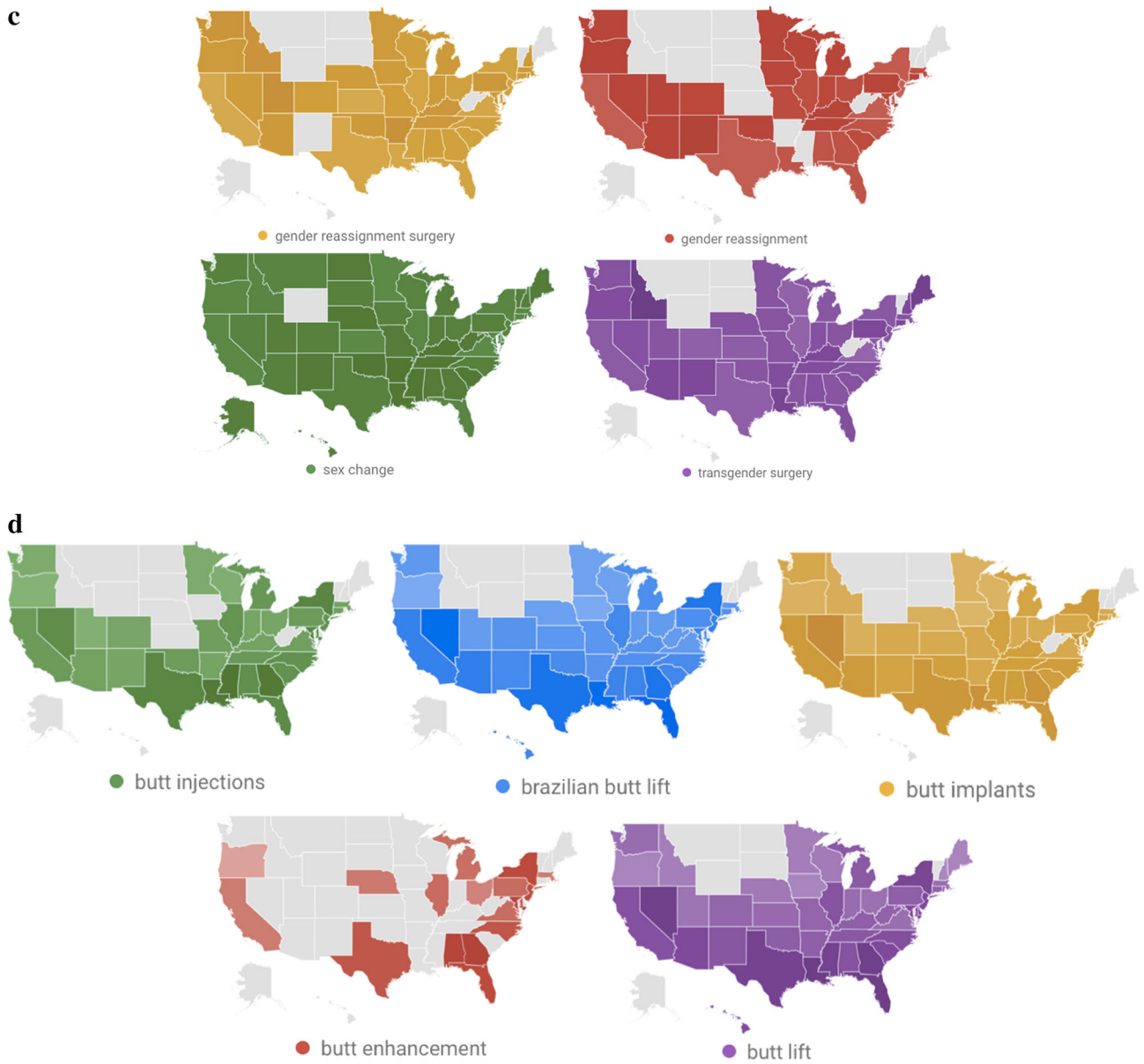


Fig. 3 continued

correlative, were relatively unrelated to actual cosmetic procedure ("butt augmentation") rumored to have been undertaken. Some terms were significantly correlated with public interest in only the short or long term, but not both. However, some discrepancies cannot easily be explained, reflecting the caution with which GT terms must be selected, and the utility of tracking multiple similar search terms for each procedure to ensure more robust trend monitoring. Similarly, while we have demonstrated that the public events we examined did have lasting effects on public interest in plastic surgery procedures, we have not characterized which qualities of these events contributed to this effect and have not characterized the types of events that have only short-lived, or an altogether insignificant effect.

Our study is not without its limitations. We have limited demographic information of the Google search users whose data are reflected in this research. We also do not know how many unique users are reflected. Furthermore, although Google receives the majority of Internet search traffic, it is ultimately one of several search engines used worldwide [31].

We do believe that despite these limitations, the power of the GT dataset allows for important conclusions to be

Table 1 Search terms used in analysis [Data source: Google Trends (www.google.com/trends)]

Procedure type	Prophylactic mastectomy	Lip augmentation	Gender affirming surgery	Buttock augmentation
Generated search terms	BRCA1	Lip augmentation	Gender affirming surgery	Brazilian butt lift
	BRCA2	Lip enhancement	Gender reassignment	Butt enhancement
	BRCA gene	Lip fillers	Gender reassignment surgery	Butt implants
	Mastectomy	Lip implants	Sex change	Butt injections
	Prophylactic mastectomy	Lip injections	Transgender surgery	Butt lift

Table 2 Percent change in public interest in the month following celebrity announcement regarding specific procedure [Data source: Google Trends (www.google.com/trends)]

Procedures and Google search terms	Percent change in search traffic in the month following celebrity announcement
Prophylactic Mastectomy, Angelina Jolie, May 2013	
BRCA1	+ 316.67
BRCA2	+ 138.10
BRCA gene	+ 354.55
Mastectomy	+ 1328.56
Prophylactic mastectomy	+ 354.55
Lip Augmentation, Kylie Jenner, May 2015	
Lip augmentation	+ 42.86
Lip enhancement	− 36.67
Lip fillers	+ 3233.3
Lip implants	+ 8.33
Lip injections	+ 13.73
Gender Affirming Surgery, Caitlyn Jenner, April 2017	
Gender affirming surgery	+ 118.75
Gender reassignment	+ 186.21
Gender reassignment surgery	+ 203.16
Sex change	+ 13.64
Transgender surgery	+ 35.48
Buttock Augmentation, Kim Kardashian, February 2014	
Brazilian butt lift	− 23.81
Butt enhancement	+ 33.80
Butt implants	+ 100.00
Butt injections	− 7.94
Butt lift	− 5.26

drawn on the topic. We believe that GT could effectively be used by plastic surgeons to track public interest in the procedures they perform and to allocate resources to meet these needs. We do, however, recommend that GT be used in conjunction with other tools, as the exact types of terms and the events to which they are sensitive are still under investigation.

In summary, this study demonstrates that high-profile celebrity announcements such as Angelina Jolie's 2013 announcement of her BRCA-influenced RRPM, as well as several cosmetic procedures recently announced by the popular culture moguls such as Kim Kardashian, Kylie Jenner and Caitlyn Jenner, may have drastic effects on public interest and real-world engagement in health care. Through this analysis, we also demonstrate that GT offers up-to-date analysis of trends in public interest, suggesting that it may represent an important asset for tracking and anticipating trends in healthcare utilization.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest to disclose.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed Consent For this type of study, informed consent is not required.

References

1. Flashback: Magic Johnson Makes Earth-Shattering HIV Announcement. Rolling Stone. www.rollingstone.com/sports/news/see-magic-johnsons-1991-hiv-positive-announcement-w449035. Accessed 21 Mar 2018
2. Kalichman SC, Hunter TL (1992) The disclosure of celebrity HIV infection: its effects on public attitudes. Am J Public Health. 82(10):1374–1376
3. Cram P, Fendrick AM, Inadomi J, Cowen ME, Carpenter D, Vijan S (2003) The impact of celebrity promotional campaign on the use of colon cancer screening: the Katie Couric effect. Arch Intern Med. 163(13):1601–1605
4. Lancucki L, Sasieni P, Patnick J, Day TJ, Vessey MP (2012) The impact of Jade Goody's diagnosis and death on the NHS Cervical Cancer Screening Programme. J Med Screen 19(2):89–93
5. Ghoncheh M, Pournamdar Z, Salehiniya H (2016) Incidence and mortality and epidemiology of breast cancer in the world. Asian Pac J Cancer Prev 17(S3):43–46
6. Chapman S, McLeod K, Wakefield M, Holding S (2005) Impact of news of celebrity illness on breast cancer screening: Kylie Minogue's breast cancer diagnosis. Med J Aust 183(5):247–250

7. Jolie A (2013) My medical choice. The New York Times: Opinion. https://www.nytimes.com/2013/05/14/opinion/my-medical-choice.html. Accessed 27 Mar 2018
8. Evans DG, Barwell J, Eccles DM et al (2014) The Angelina Jolie effect: how high celebrity profile can have a major impact on provision of cancer related services. Breast Cancer Res 16(5):442
9. Evans DG, Wisely J, Clancy T et al (2015) Longer term effects of the Angelina Jolie effect: increased risk-reducing mastectomy rates in BRCA carriers and other high-risk women. Breast Cancer Res 17:143
10. Liede A, Cai M, Crouter TF, Niepel D, Callaghan F, Evans DG (2018) Risk-reducing mastectomy rates in the US: a closer examination of the Angelina Jolie effect. Breast Cancer Res Treat 171(2):435–442
11. Salhab M, Bismohun S, Mokbel K (2010) Risk-reducing strategies for women carrying brca1/2 mutations with a focus on prophylactic surgery. BMC Womens Health 10:28
12. Guillem JG, Wood WC, Moley JF et al (2006) ASCO/SSO review of current role of risk-reducing surgery in common hereditary cancer syndromes. J Clin Oncol 24(28):4642–4660
13. Google Trends (2017) Think with Google. https://www.thinkwithgoogle.com/tools/googletrends/. Accessed 1 Apr 2019
14. Google Trends. Google Trends. https://g.co/trends/FDVVW. Accessed 13 Apr 2019
15. Vasconcellos-Silva PR, Carvalho DB, Trajano V, de La Rocque LR, Sawada AC, Juvanhol LL (2017) Using Google trends data to study public interest in breast cancer screening in Brazil: why not a Pink February? JMIR Public Health Surveill 3(2):e17
16. Pelat C, Turbelin C, Bar-Hen A, Flahault A, Valleron A (2019) More diseases tracked by using Google Trends. Emerg Infect Dis 15(8):1327–1328
17. Ward B, Ward M, Paskhover B (2018) Google trends as a resource for informing plastic surgery marketing decisions. Aesthet Plast Surg 42(2):598–602
18. Wilson SC, Daar DA, Sinno S, Levine SM (2018) Public interest in breast augmentation: analysis and implications of Google trends data. Aesthetic Plast Surg 42(3):648–655
19. Tijerina JD, Morrison SD, Nolan IT, Vail DG, Nazerali R, Lee GK (2018) Google trends as a tool for evaluating public interest in facial cosmetic procedures. Aesthet Surg J. https://doi.org/10.1093/asj/sjy267
20. Tijerina JD, Morrison SD, Nolan IT, Vail DG, Nazerali R, Lee GK (2019) Analysis and interpretation of Google trends data on public interest in cosmetic body procedures. Aesthet Surg J. https://doi.org/10.1093/asj/sjz051
21. Tijerina JD, Morrison SD, Vail DG, Lee GK, Nazerali R (2019) The utility of Google trends data for analyzing public interest in breast procedures. Ann Plast Surg 82(5S Suppl 4):S325–S331
22. Shen JK, Seebacher NA, Morrison SD (2019) Global interest in gender affirmation surgery: a Google trends analysis. Plast Reconstr Surg 143(1):254e–256e
23. Wong SM, Freedman RA, Sagara Y, Aydogan F, Barry WT, Golshan M (2017) Growing use of contralateral prophylactic mastectomy despite no improvement in long-term survival for invasive breast cancer. Ann Surg 265(3):581–589
24. Cosmetic Surgery National Data Bank Statistics (2018) Aesthet Surg J 38(suppl_3):1–24
25. American Society of Plastic Surgeons (ASPS) (2018) ASPS plastic surgery statistics report. Arlington Heights
26. Greenberg JL, Weingarden H, Wilhelm S (2019) A practical guide to managing body dysmorphic disorder in the cosmetic surgery setting. JAMA Facial Plast Surg. https://doi.org/10.1001/jamafacial.2018.1840
27. Rajanala S, Maymone MBC, Vashi NA (2018) Selfies-living in the era of filtered photographs. JAMA Facial Plast Surg 20(6):443–444
28. Juthe RH, Zaharchuk A, Wang C (2015) Celebrity disclosures and information seeking: the case of Angelina Jolie. Genet Med 17(7):545–553
29. Noar SM, Althouse BM, Ayers JW, Francis DB, Ribisl KM (2015) Cancer information seeking in the digital age: effects of Angelina Jolie's prophylactic mastectomy announcement. Med Decis Mak 35(1):16–21
30. Borzekowski DL, Guan Y, Smith KC, Erby LH, Roter DL (2014) The Angelina effect: immediate reach, grasp, and impact of going public. Genet Med 16(7):516–521
31. Internet live stats. https://www.internetlivestats.com/ google-search-statistics/. Accessed 15 Mar 2019