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Public Interest in Knee Replacement Fell During the Onset of the COVID-19 Pandemic: A Google Trends Analysis

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Abstract *Background:* The COVID-19 pandemic significantly altered medical practice and public behavior in the USA. In spring of 2020, elective surgery including most joint replacement was suspended and much of the public asked to stay at home. As elective surgery resumes, it is unknown how the public will respond. *Questions/Purposes:* We sought to describe public interest in knee replacement during the onset of the COVID-19 pandemic. *Methods:* Google Trends was used to obtain the daily number of searches for "knee replacement," "coronavirus," and "knee pain" from December 19, 2019, to May 14, 2020. The number is on a term-specific scale weighted to the highest number of daily searches for that term. Seven-day weighted averages were used to smooth the data. *Results:* The number of daily searches for "knee replacement" was stable until around March 8, 2020, after which it decreased through late March, plateauing at less than half the number of searches. At the same time, searches for "coronavirus" spiked. By early May, searches for "knee replacement" had not meaningfully increased, though at the end of the search period the slope turned positive and coronavirus searches decreased. Searches for "knee pain" initially followed a similar pattern to "knee replacement," though the decline was not as steep, and by late April searches for "knee pain" had meaningfully increased. *Conclusion:* Public interest in knee replacement, assessed through internet search queries, decreased during the onset of the COVID-19 pandemic. While interest in pain has returned, the continued decreased level of interest in surgery may represent a fear of surgery among the general public in the setting of COVID-19. Surgeons may wish to focus outreach and education efforts on the safety and efficacy of knee replacement.

Keywords COVID-19 · arthroplasty · replacement · knee · public health · health services research

This research project utilized publically available data that did not include any specific human subjects and there was no identifying information. To this point, the Google Trends tool does not allow for reporting of search results for less popular searches. This was a motivating factor behind reporting results for knee arthroplasty, one of the most common elective surgeries.

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Introduction

The first cluster of cases attributed to the novel coronavirus-19 disease (COVID-19) was reported in China on December 31, 2019 [26]. The first case in the USA was reported in Washington State on January 21, 2020. As additional cases appeared in the USA, various governmental responses resulted in changes to the healthcare system and public behavior. Elective surgery, including most knee arthroplasty, was suspended across much of the USA in March, either in compliance with various regulations or voluntarily by hospitals [24]. In mid-March the federal government announced "15 Days to Slow the Spread," a campaign that encouraged sick, exposed, or vulnerable populations to stay at home. Around this time, many states enacted stay-at-home orders and travel bans restricting movements of the public. By March 26, 2020, the USA led the world in confirmed cases and had attributed 1000 deaths to COVID-19 [5].

During April 2020, COVID-19 continued to spread across the country, though many severely affected areas including New York had begun to see a plateauing in new cases, hospital utilization, and deaths [5, 16]. In May 2020, many states began loosening restrictions on the public and businesses, challenging hospitals and surgeons with safely and sustainably resuming elective surgery to meet patient demand. A recent data simulation predicted this wave of the pandemic could end with a backlog of over 1 million orthopedic cases [11]. While knee arthritis can be severely debilitating and some patients waiting for surgery may report a quality of life comparable to death [21], little is known regarding how public interest has changed during this pandemic. A recent patient survey found demand for knee replacement could be high when elective surgery resumes, though historical data suggests this could be tempered by other factors [10, 18].

This study sought to characterize public interest in knee replacement at the onset of the COVID-19 pandemic by utilizing search engine query data.

Methods

The Google Trends tool was utilized on May 20, 2020, to obtain the daily number of searches for "knee replacement," "coronavirus," and "knee pain" that had been conducted in the USA from December 13, 2019, to May 14, 2020. The queries were run separately for each search term. The value obtained for the number of daily searches was reported on a search term–specific scale from 0 to 100. On this scale, 100 represents the number of searches on the day with highest number of searches and zero represents the minimum number of searches needed to be reportable. The value for the other days is weighted

proportionally such that a value of 50 is equivalent to a number of daily searches that is half the maximum number of daily searches. In this way, the number of daily searches reported is relative to each specific term and that trends, but not absolute number of searches, can be compared across terms. A running 7-day average was calculated for each search term to smooth the data. This data was then plotted over time and events related to the COVID-19 pandemic labeled by date to provide context.

Results

The number of daily searches for knee replacement was stable until the days around March 8, 2020, when searches began to decrease (Fig. 1). This decline was after many events related to the COVID-19 including the USA-imposed Chinese travel ban, the first US death, and the excessive volatility of global stock markets. Searches for knee replacement then continued to decrease through the days around March 30, 2020, when they eventually plateaued at a daily search rate less than half the prior rate. The USA declared national emergency occurred after the decline had begun but prior to the plateau.

Around the same days that knee replacement searches began to decrease, searches for coronavirus spiked (Fig. 2). While searches for coronavirus began decreasing shortly after the spike with an inverted V-shaped curve, searches for knee replacement did not follow this pattern and remained decreased though at the end of the search period the slope had appeared to become positive.

Around the same days that knee replacement began to decrease, searches for knee pain also decreased (Fig. 3). The relative decrease in searches for knee pain was not as great for knee pain as for knee replacement. Additionally, searches for knee pain did
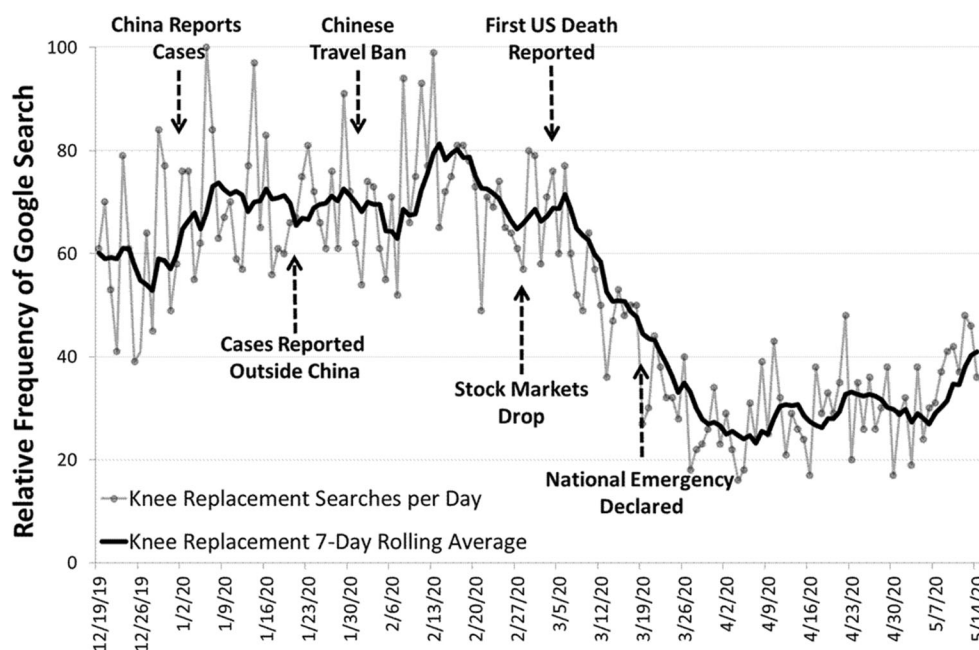

Fig. 1. Google searches for knee replacement by day where gray circles represent the daily value and are connected by a light gray line. The 7-day rolling average for knee replacement searches is represented by a black line.
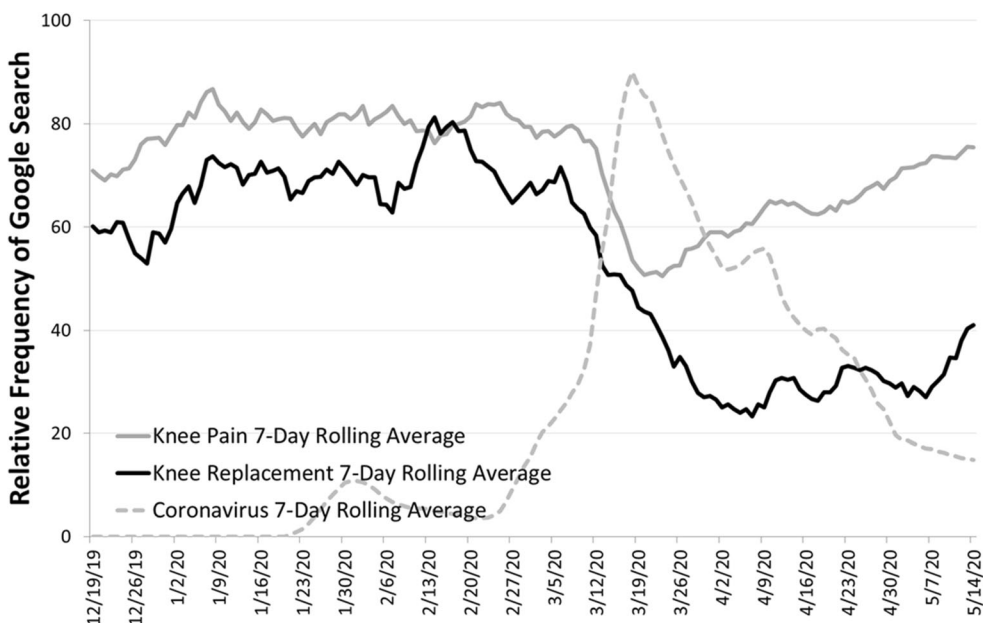
Fig. 2. The 7-day rolling average for knee replacement searches by day is represented by a black line. The 7-day rolling average for coronavirus searches is represented by a dashed gray line.

not continue to decrease for as many days as knee replacement with searches beginning to increase again in the days around March 24, 2020. While searches for knee pain had nearly returned to prior values by early May, searches for knee replacement remained decreased.

Discussion

Surgeons and hospitals face several challenges as elective knee replacements resume after the initial onset of the COVID-19 pandemic. With recent attention given to behavior patterns and patient anxiety about elective surgery [2], it is unclear how patient demand for knee replacement will be affected. In this study, we found that public interest in knee replacement assessed through internet search queries decreased during the onset of the COVID-19 pandemic to a rate less than half that seen prior to the onset of the pandemic. While this decrease coincided with a spike in searches for coronavirus and a decrease in searches for knee pain, searches for knee replacement did not increase to the same magnitude as searches for coronavirus decreased and searches for knee pain increased.
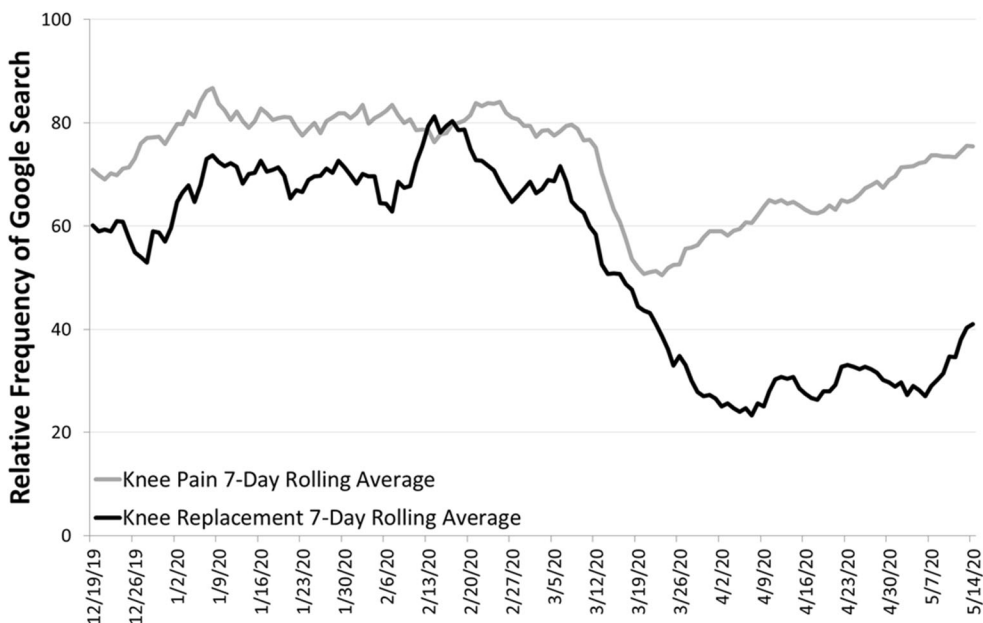

Fig. 3. The 7-day rolling average for knee replacement searches by day is represented by a black line. The 7-day rolling average for knee pain searches is represented by a gray line.

The effect of the COVID-19 pandemic on the economy has been severe. According to the US Jobs Report, more than 20 million Americans lost their jobs in April 2020 [3]. The rate of unemployment and economic downturn may ultimately exceed that of the Great Recession in 2008, which had a significant impact on arthroplasty volumes. A 2009 survey of the American Association of Hip and Knee Surgeons (AAHKS) revealed that surgical and patient volume dropped 30% due to the 2008 Great Recession [17]. Tenuous individual patient finances, lack of or a change in health insurance status, or patients' pre-occupation with more pressing life matters all may have been factors that led to a reduction in arthroplasty volume after the 2008 Great Recession.

End-stage hip and knee arthritis can lead to severe pain and functional limitations. In an analysis of roughly 4000 patients who underwent total hip or knee arthroplasty (THA or TKA), Scott et al. reported that 19% of patients awaiting THA and 12% of patients awaiting TKA for osteoarthritis were in a health comparable to "worse than death" during the waiting period [21]. It is unknown how patients will balance functional limitations with their fears and anxiety over the COVID-19 pandemic in deciding whether to proceed with elective knee replacement. A recent survey conducted by AAHKS of 360 patients who had their elective hip or knee arthroplasty canceled secondary to COVID-19 found that 90% of patients plan to reschedule their elective surgery as soon as possible [2]. Most of those patients surveyed also stated they had significant anxiety about the COVID-19 pandemic, and the potential for response bias in this survey is unknown.

The outcomes of patients operated on during the COVID-19 pandemic are unknown. While evidence suggests surgery on patients with COVID-19 is associated with a poor prognosis [9], with some studies indicating pulmonary complications in half of patients with peri-operative COVID-19 [1], it is unclear whether this is due to an interaction between infection and surgery or simply a reflection of the poor outcomes associated with infected patients requiring hospitalization. It is unknown whether the outcomes of non-affected patients are being influenced during the pandemic. Preventing nosocomial spread to elective surgery patients is a large focus of surgeons and hospitals. Given that knee replacement patients tend to be older and many have comorbidities, this is an especially relevant consideration. Additionally unknown is whether patients with prior COVID-19 will have worse surgical outcomes and, if so, for how long the association persists after infection.

Analyses of search engine query data have been used to track public interest and behavior and have even been shown to accurately track viral epidemics [7, 20, 22]. Ginsberg et al. [6] reported that an analysis of the frequency of Google searches for influenza symptoms highly correlated with the number of physician visits for influenza-like symptoms and could be accurately utilized to estimate the burden of influenza in each region of the USA at any given point in time. Furthermore, in orthopedics, analysis of Google Trends has been previously utilized to gauge public interest in various procedures over time. Strotman et al. [23] utilized Google Trends to show a significant increase in public interest and popularity of stem cell injections for osteoarthritis of the hip and knee.

During the peer review of this research, a similar study by Jella et al. was published [12]. Our findings are consistent, with both studies reporting a sharp decline in internet searches for "knee replacement" in March 2020, during the onset of the COVID-19 pandemic in the USA. There are some differences worth noting. The present study analyzes searches at the day-level as opposed to month-level, which allows for a more precise exploration of search data during the month of March. The present study also included the reference search term "knee pain," which provides additional context.

This data should be interpreted in the context of significant limitations. While prior studies have utilized search engine query data to quantify and track public interest, internet searches may not accurately reflect the interests of specific subgroups such as patients considering knee replacement. Furthermore, the association between interest in surgery and electing to have surgery may be limited. It is also not possible to use this data to understand what specific factors underlie a change in public interest. Especially in this pandemic, public interest may vary due to financial constraints, new social obligations, or concerns regarding hospital safety. The search terms are also not perfectly specific. For instance, "coronavirus" and "COVID" produce results with minor variation.

Google Trends data has been used as an indicator to predict demand in various industries and markets including real estate, automobile sales, and travel [4, 25]. However, it is still unclear how well search query trends can be used to forecast changes in demand within healthcare. Using past data to make future projections is complicated, especially when the model is largely data-driven and not reliant on a fuller understanding of the factors that predict the outcome. Given this, we did not attempt to model our data to make future projections.

Prior works estimating future demand for elective arthroplasty using historical data to model have predicted continued growth in both primary THA and TKA throughout the next decade, based on models that also demonstrated relative insensitivity of the demand to the economic downturn in 2009 [13, 14]. Although elective arthroplasty arguably demonstrated income inelastic demand in these models, there is data to suggest higher elasticity of demand for elective surgery overall in respect to waiting times [15], which could contribute to the recently observed decrease in interest during the COVID-19 pandemic.

Hospitals and surgeons face challenges in resuming elective surgery. The American Association of Orthopaedic Surgeons (AAOS) and AAHKS have published guidelines [8, 18] to assist in efficiently and safely making this transition. However, the volume of patients who seek elective arthroplasty is unknown. After the 2008 Great Recession, there was a 30% reduction in volume for elective joint replacement [10]. In the current study utilizing Google Trends analysis to quantify and track public interest in total knee replacement, there has been decreased public interest in knee replacement, and that interest has yet to demonstrate a significant rebound. As this is not true for interest in knee pain, it is unlikely that pain has simply become less important. More likely, patients with knee pain are concerned about the safety of surgery and may be delaying care or

looking for alternative treatment options. We therefore recommend that surgeons and our representatives focus on outreach and education regarding the safety and efficacy of knee replacement. Furthermore, as surgeons begin to resume elective knee replacement, they should be educating patients on the precautions being undertaken to ensure patient safety is of paramount importance in these uncertain times [19].

Compliance with Ethical Standards

Conflict of Interest: David C. Landy, MD, PhD, Brian P. Chalmers, MD, and Thomas J. Utset-Ward, MD, MBA, declare that they have no conflicts of interest. Michael P. Ast, MD, reports royalties, speaker and consultant fees, and stock from OrthAlign, Inc.; speaker and consultant fees from Stryker and Smith & Nephew; consultant fees and stock from Osso VR; and consultant fees from Surgical Care Affiliates, outside the submitted work.

Human/Animal Rights: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2013.

Informed Consent: N/A

Required Author Forms Disclosure forms provided by the authors are available with the online version of this article.

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