



Original research

Publication Frequency and Google Trends Analysis of Popular Alternative Treatments to Arthritis

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ABSTRACT

Background: Public interest in alternative, nonoperative treatments for the management of arthritis has increased. Few have been approved by the Food and Drug Administration. The present study aimed to evaluate trends in public and scientific interest in 4 such treatments by assessing Google Trends and publication frequency data, respectively.

Material and methods: Turmeric, stem cell therapy, platelet-rich plasma (PRP) therapy, and cannabidiol (CBD) were studied. For 2010–2019, Google Trends data and publication frequency data on PubMed were collected by year for arthritis and each of the 4 therapies. Linear, quadratic, and exponential regressions were applied, and the best model of growth was identified.

Results: From 2010 to 2019, Google Trends annual scores for arthritis and turmeric (exponential; R^2 : 90.5%, $P < .001$), CBD (exponential; R^2 : 99.3%, $P < .001$), stem cell therapy (exponential; R^2 : 86.7%, $P < .001$), and PRP therapy (linear; R^2 : 80.6%, $P < .001$) increased significantly. Search term frequencies for arthritis and CBD exhibited the highest increase (12,929%). Publications in arthritis and turmeric (linear; R^2 : 74%, $P = .001$), stem cell therapy (linear; R^2 : 94.8%, $P < .0001$), and PRP therapy (linear; R^2 : 97.1%, $P < .0001$) increased from 2010 to 2019. However, publications relating to arthritis and CBD have not increased ($P = .122$).

Conclusion: Regression analysis indicates that public interest in alternative therapies have had a marked increase. The rise in public interest for CBD, and to a lesser extent, turmeric, stem cell therapy, and PRP, has dramatically outstripped scientific evidence on these therapies. Rigorously designed, clinical studies may be beneficial to keep up with the growing popularity of these treatments, especially CBD.

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Introduction

There has been increasing public interest in “alternative” nonoperative treatments for musculoskeletal conditions, especially for the management of arthritis [1–4]. Most of these treatments have not been approved by the Food and Drug Administration (FDA), and thus, their efficacy and adverse effect profiles are not fully understood by physicians [1].

Many of these treatments are new to the market and may be heavily driven by commercial interests [5]. Despite a lack of FDA

approval, there is much touting such arthritis treatments on social media platforms [6], potentially diverting patients from well-studied, evidence-based treatments.

In 2019, Strotman et al. studied Google Trends data and found that search term frequencies for stem cell therapy as an arthritis treatment have increased over the past several years [7]. There has been a lack of published literature assessing if there has been a concomitant increase in publication frequency of therapies such as these.

Given the significant financial burden and potential health considerations associated with treatments such as turmeric, stem cell therapy, platelet-rich plasma (PRP), and cannabidiol (CBD), the present study aimed to assess contemporary trends in scientific publications as well as Google search term frequency (“Google Trends”) related to alternative therapies for arthritis.

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Material and methods

Google Trends

Google Trends aggregate scores were studied for 4 of some of the most common alternative treatments in the context of arthritis: turmeric, CBD, stem cell therapy, and PRP therapy. These 4 treatments were chosen as the basis of this study after discussing with the arthroplasty attendings at our institution and performing a literature review on common alternative arthritis treatments. As these data are publicly available, institutional review board approval was not required.

Google Trends is an online platform that enables analysis of how frequently terms are searched on the Google website. In the present study, “search terms” were searched, as opposed to “search topics.” Search terms in the Google Trends website factor in varied forms of the same search term in determining aggregate popularity. For example, using MCL (medial collateral ligament) as a search term would include aggregate popularity scores for “medial collateral ligament.” Of note, searches were limited to the United States and performed through Google’s health search query function.

Google Trends formulates an output that characterizes the volume of searches for a specific search term. The Google Trends data are essentially relative search volumes; data are reported as ratios comparing searches for a distinct topic (“search term”) to the total number of Google searches. Ratios range from zero (minimal popularity) to 100 (maximum popularity).

Thus, Google Trends data were obtained from January 1, 2010, to December 31, 2019, for the following search term combinations: arthritis turmeric, arthritis CBD, arthritis stem cell therapy, and arthritis PRP. As Google Trends provides data per month, monthly scores were added for each year to obtain 10 “aggregate annual scores.” The score in 2010 for each alternative treatment was set to zero as a baseline, and the scores for 2011–2019 were similarly adjusted to allow for regression analysis.

Linear, quadratic, and exponential regressions were applied to identify best fit for each of the Google Trends data sets for the 4 alternative treatments. R-squared values and P values (alpha < .05 for significance) were recorded.

Publication frequency

To identify if changes in publication frequency mirror changes in search term frequency, data from PubMed were retrieved. Whenever a term or combination of terms are searched on this website, PubMed offers data on how many manuscripts on this topic (or topics) were published annually over the past several years.

Thus, publication frequency was determined by year for the 2010–2019 period for arthritis and turmeric, CBD, stem cell therapy, or PRP therapy. Publication frequency was graphed by year to determine percent increase or decrease over the decade.

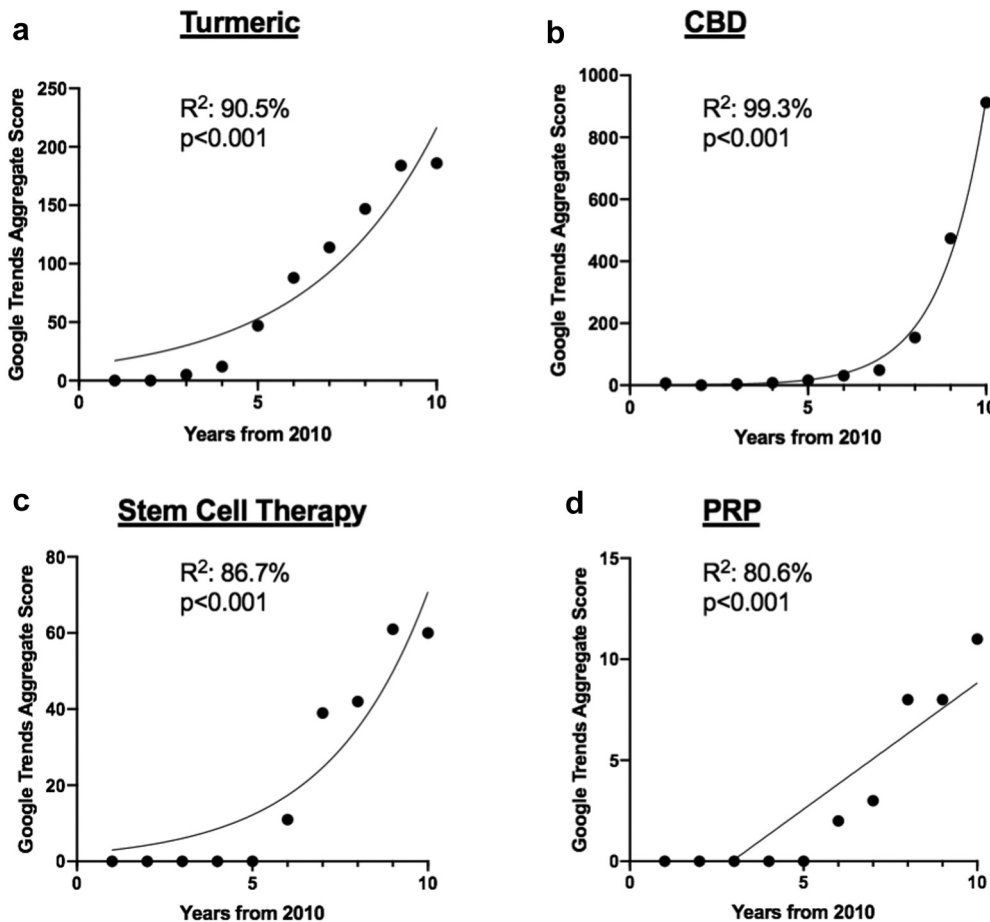


Figure 1. Google Trends data (annual aggregate scores) for arthritis and (a) turmeric, (b) CBD, (c) stem cell therapy, and (d) PRP therapy. The best model of growth (based on R² values) is shown.

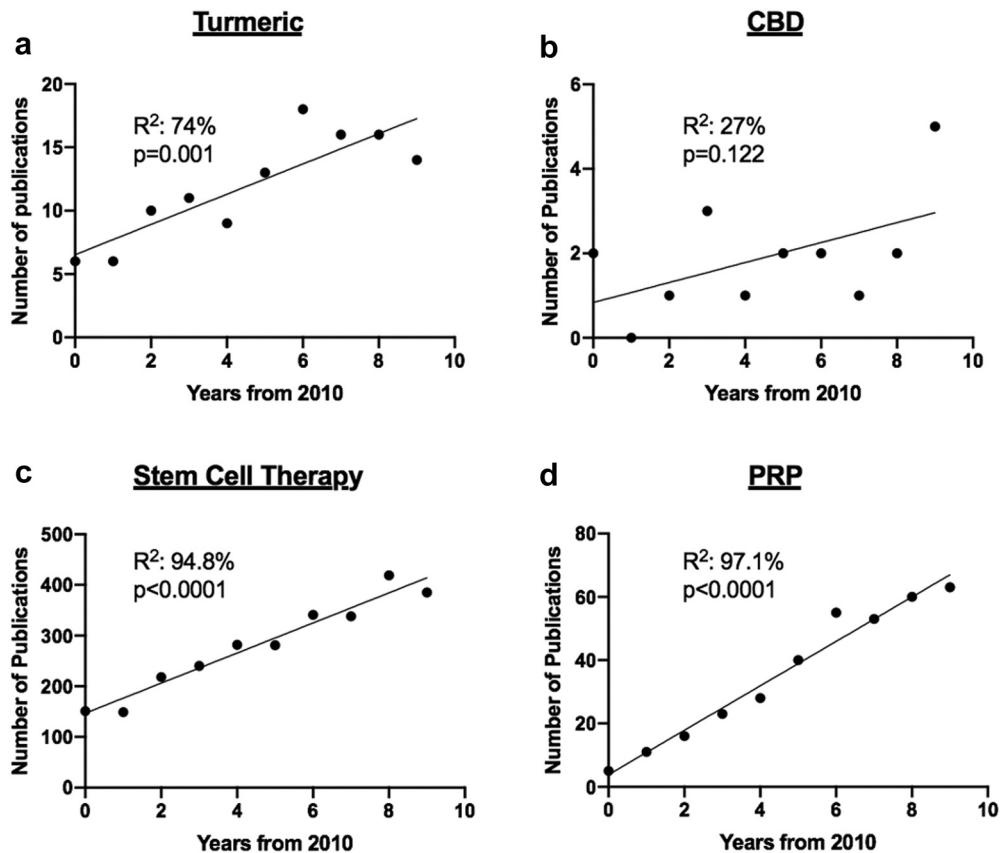


Figure 2. Publication frequency (PubMed) data for arthritis and (a) turmeric, (b) CBD, (c) stem cell therapy, and (d) PRP therapy. The best model of growth (based on R² values) is shown.

Statistical methods

All statistical analyses and construction of figures and tables were performed in Stata 13 (StataCorp, College Station, TX), Microsoft Excel (Microsoft, Redmond, WA) and GraphPad Prism. (GraphPad, San Diego, CA).

Results

Google Trends

For the “arthritis turmeric” search term combination, Google Trends aggregate annual scores were graphed for 2010–2019 (Fig. 1). After linear, quadratic, and exponential regression models were fitted, R-squared analysis showed that the exponential regression was the best model that described the growth in Google Trends scores (R²: 90.5%, $P < .001$). From 2010 to 2019, there was an increase in US public interest by 186 aggregate score points.

For the “arthritis CBD” search term combination, Google Trends aggregate annual scores were graphed. An exponential regression was deemed the best fit model (R²: 99.3%, $P < .001$). From 2010 to 2019, the US public interest in CBD treatments for arthritis increased by 905 Google Trends aggregate score points.

For the “arthritis stem cell therapy” search term combination, Google Trends aggregate annual scores showed that an exponential regression was the best fit model of growth (R²: 86.7%, $P < .001$). From 2010 to 2019, the Google Trends aggregate annual score for this alternative treatment in the context of arthritis treatment increased by 60 points.

Finally, for “arthritis PRP therapy” search term combination, Google Trends aggregate annual scores showed a linear regression to be the best model of growth (R²: 80.6%, $P < .001$). From 2010 to 2019, the annual Google Trends aggregate annual score increased by 11 points.

When assessing percent increases in Google Trends aggregate values, annual scores increased the most for arthritis and CBD (12,929%), followed by turmeric (278%), stem cell therapy (107%), and PRP therapy (52%).

Publication frequency

Publications on “arthritis” and one of the following alternative treatments were searched on PubMed: turmeric, CBD, stem cell therapy, and PRP therapy (Fig. 2). Publications for arthritis and turmeric (R²: 74%, $P = .001$), stem cell therapy (R²: 94.8%, $P < .0001$), and PRP therapy (R²: 97.1%, $P < .0001$) increased in a linear fashion from 2010 to 2019. However, publications for CBD remained similar across this decade (R²: 27%, $P = .122$).

When assessing percent increases, publications for arthritis and PRP therapy increased the most over the decade (1160%).

Discussion

Over the past several years, the number of patients seeking alternative treatments to arthritis has increased [8–10]. However, several of these treatments are yet to be approved by the FDA, and thus, their efficacy and side effects profile remains unclear. The goal of the present study was to assess and compare trends in public interest (quantified by Google Trends aggregate scores) for 4

alternative arthritis treatments and trends in publication frequency from 2010 to 2019.

Google Trends data regarding stem cell therapy for arthritis have been investigated previously [7]. In this previous investigation, Strotman et al. showed that public interest, as quantified by Google Trends data, increased significantly in the previous decade [7]. However, to the best of the authors' knowledge, the present study is the first to evaluate Google Trends data for turmeric, CBD, and PRP therapy in the context of arthritis treatment.

Turmeric, a spice that is obtained from the *Curcuma longa* plant, is widely available in dietary supplements. One-thousand-milligram capsules are the only United States Pharmacopeia-verified formulation of turmeric that is available to consumers. Even though turmeric has not been approved by the FDA, a recent meta-analysis has shown that turmeric is associated with alleviation of pain related to arthritis [11].

CBD is promoted as a therapeutic product that has been shown to have beneficial effects on pain and inflammation in preclinical studies [12]. However, clinical studies on its impact on arthritis management are lacking. CBD formulations are available to consumers over the counter and are promoted as supplements. The World Health Organization has stated that pure CBD is safe with minimal abuse potential [13]. Furthermore, it is important to note that according to the 2018 Farm Bill, non-tetrahydrocannabinol CBD products are not illegal in any US state [14]. However, when these commercial products are marketed as supplements and not placed under rigorous regulatory standards, there is a risk for differing product quality levels and possible contaminants [14].

Stem cell therapy and PRP therapy are 2 alternative, injection-based treatments that have also increased in popularity over the past few years in the context of arthritis treatment. Mesenchymal stem cells have been shown to decrease growth of proteolytic enzymes responsible for the degeneration of cartilage [15]. PRP involves injections of a concentrate that contains a patient's own platelets, proteins, and growth factors [16]. It is hypothesized that PRP therapy has positive effects on various bodily processes such as anti-inflammation, chondrocyte growth, and cartilage repair [17]. However, stem cell therapy and PRP are also yet to be approved by the FDA.

The results of the present study indicate an increase in the number of Google searches from 2010 to 2019 for turmeric, CBD, PRP, and stem cell therapy. Based on regression analyses, there should be an expected, continued increase in public interest (as quantified by Google searches) over the next several years. Consequently, orthopedic surgeons should be prepared to expect more questions on the validity of these therapies from their patients.

Google Trends aggregate annual scores increased the most (12,929%) and in exponential fashion for "arthritis CBD." Interestingly, publications for CBD in the context of arthritis treatment have stayed relatively stable ($P = .122$). These results indicate a potential delay in the scientific and medical community responding to a relatively new patient interest. Furthermore, it is possible that scientists and physicians are discouraged from conducting research trials on CBD, due to societal stigma revolving around marijuana-based products [18]. Nonetheless, the present exponential regression analysis indicates that interest in CBD treatments for arthritis will continue to increase at a high rate; there is, therefore, a need for more robust trials to investigate the efficacy and safety profile of CBD.

For turmeric, stem cell, and PRP therapies as arthritis treatments, regression analyses on Google Trends data indicate growth over the past decade. Publications on all 3 of these alternative therapies as treatments for arthritis have also increased in a linear fashion from 2010 to 2019. It appears that scientific research on

these therapies will continue to increase in a linear fashion based on regression analysis. Further randomized, controlled trials will help provide more information on these treatments and may lead to possible FDA approval.

The present study has several limitations. First, Google Trends stems from a large data set that contains anonymous data, which may result in sampling bias. However, Google is the largest search engine online, with more than 2 trillion searches per year, which reduces this bias risk. Furthermore, the present findings do not include people who do not have access to Internet or searched for alternative therapies on other search engines. Nonetheless, the present study used the largest data set of internet search data available.

Conclusion

In summary, the results from this study suggest that public interest, quantified through Google Trends aggregate data, for these alternative treatments may continue to increase over the coming years. While publications relating to turmeric, stem cell therapy, and PRP have notably increased over the past decade, literature studying the impact of CBD on arthritis progression and symptomatic management has not increased. The rise in public interest for CBD, and to a lesser extent, turmeric, stem cell therapy, and PRP, has dramatically outstripped scientific evidence on these therapies. Rigorously designed clinical studies may be beneficial to keep up with the growing popularity in these treatments—especially for CBD.

Conflicts of interest

J. N. Grauer is in the editorial or governing board of North American Spine Society Journal and is a board member in North American Spine Society Journal, Lumbar Spine Research Society, and Cervical Spine Research Society. L. E. Rubin is a paid consultant for DePuy-Synthes and ConvaTec; is in the editorial or governing board of Journal of Arthroplasty, Arthroplasty Today, and Reconstructive Review; and is a board member of the American Academy of Orthopaedic Surgeons.

For full disclosure statements refer to <https://doi.org/10.1016/j.artd.2021.12.009>.

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