

Google Trends and Seasonal Patterns in Gout Infodemiology: Made More Crystal-Clear

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Google Trends and Seasonal Patterns in Gout Infodemiology: Made More Crystal-Clear

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Abstract

Background: Gout is a common inflammatory arthritis with well-documented seasonal variation in flares. Understanding public interest in gout, as reflected in online behavior, can provide valuable insights into disease perception and management, particularly when tracking interest patterns over time and across different regions.

Objective: To explore whether the public interest in gout, as measured by Google Trends data, exhibits seasonal patterns across countries, US states, and major metropolitan areas. Additionally, the study evaluates the impact of language-specific search terms on the observed seasonality of gout-related queries.

Methods: This study utilizes Google Trends data from January 1, 2014, to October 1, 2024, to analyze the frequency of gout-related search queries. Data were collected from 70 countries, 50 US states, and 36 major cities in the US and Canada. Both direct searches for “gout” and symptom-based searches were included, along with queries in multiple languages.

Results: The analysis revealed significant seasonal variation in gout-related search interest in 40 US states and 20 of the 70 countries analyzed, with peaks in the late spring/early summer for the Northern Hemisphere and corresponding shifts in the Southern Hemisphere. Symptom-based queries also displayed strong seasonality, aligning with known clinical patterns of gout flares. The use of language-specific search terms further refined the detection of seasonal patterns, strengthening the findings.

Conclusions: Public interest in gout, as reflected by Google search behavior, follows a clear seasonal pattern, mirroring the clinical seasonality of gout flares. This study highlights the utility of infodemiology as a supplementary tool for understanding public behavior and informing health communication strategies. Accounting for linguistic nuances enhances the precision of seasonality analysis, offering valuable insights for public health efforts aimed at improving disease management and patient education. Clinical Trial: N/A

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Original Manuscript

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Key Points

Question: What is public interest in gout, the most common inflammatory arthritis in humans worldwide, teach us about the seasonality of gout?

Findings In this cross-sectional study, an analysis of Google Trends data from January 2014 to October 2024 revealed significant seasonal variations in search interest, with notable differences in patterns across geographical regions. This seasonality aligns with the known seasonality of gout flares, possibly reflecting the broader environmental and climatic influences on gout.

Meaning: Interest in gout underscores the importance of integrating diverse data sources to understand a disease, in this case, gout, can provide valuable insights into disease perception and management.

Keywords

Gout
Google Trends
Seasonal Variation
Infodemiology
Search Behavior
Public Health
Language-Specific Search Terms
Seasonality Analysis

Abstract

Background

Gout is a common inflammatory arthritis with well-documented seasonal variation in flares. Understanding public interest in gout, as reflected in online behavior, can provide valuable insights into disease perception and management, particularly when tracking interest patterns over time and across different regions.

Objective

To explore whether the public interest in gout, as measured by Google Trends data, exhibits seasonal patterns across countries, US states, and major metropolitan areas. Additionally, the study evaluates the impact of language-specific search terms on the observed seasonality of gout-related queries.

Methods

This study utilizes Google Trends data from January 1, 2014, to October 1, 2024, to analyze the frequency of gout-related search queries. Data were collected from 70 countries, 50 US states, and 36 major cities in the US and Canada. Both direct searches for “gout” and symptom-based searches were included, along with queries in multiple languages.

Results

The analysis revealed significant seasonal variation in gout-related search interest in 40 US states and 20 of the 70 countries analyzed, with peaks in the late spring/early summer for the Northern Hemisphere and corresponding shifts in the Southern Hemisphere. Symptom-based queries also displayed strong seasonality, aligning with known clinical patterns of gout flares. The use of language-specific search terms further refined the detection of seasonal patterns, strengthening the findings.

Conclusions

Public interest in gout, as reflected by Google search behavior, follows a clear seasonal pattern, mirroring the clinical seasonality of gout flares. This study highlights the utility of infodemiology as a supplementary tool for understanding public behavior and informing health communication strategies. Accounting for linguistic nuances enhances the precision of seasonality analysis, offering valuable insights for public health efforts aimed at improving disease management and patient education.

Introduction

Gout is the most prevalent inflammatory arthritis globally. Gout is a metabolic disease characterized by an elevated uric acid pool leading to the formation and deposition of monosodium urate (MSU) crystals, recently identified as an auto-inflammatory disease [1]. The prevalence of gout is on the rise, partly due to the obesity epidemic, impacting 5.1% (12.1 million) of US adults, 5.9% of men, and 2.0% of women [2]. The likelihood of developing gout increases with age, affecting 10% of whites aged ≥ 65 years and 14.8% of Asians aged ≥ 65 years, although it can affect adults of any age [3, 4]. The primary goals of gout treatment are to prevent the formation of MSU crystals, reduce their deposition, and reduce inflammation.

Gout flares exhibit a strong seasonal pattern, with incidents peaking in the spring [5-8]. This seasonal trend is puzzling since serum urate levels fluctuate seasonally and are highest in the summer. Furthermore, the functioning of the immune system in vertebrates shows significant seasonal variation, with heightened immune responses and increased disease severity during the shorter winter days as organisms adjust to the cold-related stresses of winter [9]. Research showed that levels of interleukin (IL)-6, its soluble receptor, and C-reactive protein (CRP) are elevated during the summer and winter months [10, 11]. These are associated with gouty inflammation. The microbiome's critical role was recently identified as a likely contributor to gout's seasonality [12]. Since distinct, cross-regulating seasonal activity patterns characterize metabolic and immune mediators, it is critical to understand these interacting dynamics better.

Traditional methods for tracking the seasonality of chronic inflammatory diseases involve epidemiological approaches that gather and analyze clinical data, environmental data, and population health metrics over time. Infodemiology refers to studying the distribution and determinants of information on the internet and its impact on public health and policy [13]. As a discipline, infodemiology is particularly valuable in tracking and analyzing the dynamics of chronic inflammatory diseases, especially in understanding their seasonality and how symptoms and disease activity may fluctuate with changes in the environment across different times of the year. Infodemiology bridges the gap between traditional epidemiology and modern digital data analysis and enriches our understanding of chronic inflammatory diseases. Integrating environmental data with infodemiology further enhances the ability to study disease seasonality. This approach ultimately supports more effective public health strategies and interventions tailored to the rhythms of both human behavior and environmental factors, enhancing our ability to manage and mitigate the impacts of chronic inflammatory diseases.

Almost all universal internet access changes the relationship between patients, their attitudes toward health concerns, and their doctors. The "Dr. Google" effect is now well-documented and established [14].

We sought to answer whether the frequency with which the public expresses their interest in "gout," quantified by the volume of Google queries, reflects seasonal patterns on a per-country basis worldwide, on a per-state basis across the USA, and finally across several major metropolitan areas in North America.

Methods

Google Trends

Google dominates the global search engine market, with a market share consistently exceeding 80% and reaching over 90% in some regions[15]. This translates to a staggering volume of approximately 8.5 billion daily searches. Google Trends[16] is a publicly accessible tool. Rather than showing raw search counts, Google analyzes a sample of searches and normalizes the data

on a scale of 0 to 100. Google trends were scored on a relative scale where a value of 100 is the most searched query in the time period and location, 50 is a query searched half as often as the top related query, and so on.

We performed several queries to obtain a comprehensive view of the geographical distribution of the public's interest in "gout." Although Google Trends reports query information as of 01/01/2004, based on a preliminary review, we opted to concentrate on the last decade (01/01/2014 – 10/01/2024) since this is a period for which more consistent data is available. To complete the remaining months of 2024, we performed a simple imputation analysis using the distribution of October-December from previous years. This step was performed to achieve the exact monthly measurements across all years. We performed three types of query searches:

- 1) Using the English term "gout" as the search keyword, we analyzed the query distribution for 70 countries around the globe, 50 US states, and 36 major metropolitan areas in North America
- 2) Using 14 language-specific expressions for the term "gout" in Czech, Danish, Dutch, French, Finnish, German, Greek, Italian, Norwegian, Romanian, Spanish, and Swedish, we examined the query distribution in 30 countries around the globe; and finally
- 3) We examined the frequency distribution of queries related to gout symptoms without mentioning the term gout reflecting public interest in symptoms whose cause is yet to be determined: "burning big toe," "stiff big toe," "big toe joint pain," "pain in the big toe," "sore big toe," "throbbing toe pain," "swollen big toe". Furthermore, we examined queries related to requesting information likely once a gout diagnosis has been provided or expressing the possibility of self-diagnosis: "gout doctor," "gout diabetes," "gout attack," "gout flare," "gout cure," "gout diet," "gout symptoms," "gout high blood pressure," "gout treatment," "nonsteroidal anti-inflammatory drug (NSAID) gout," "prednisone gout."

Model development and analysis

The averaged monthly data are analyzed using a standard cosinor model, a harmonic regression tailored for analyzing and quantifying periodic (monthly in our case) variations observed in time-series data. This model fits a sinusoidal curve to the monthly search frequency data, aiming to capture any inherent cyclic behavior over each year. We implement a two-tail test and determine an appropriate p_{val} to evaluate the statistical significance of asserting that the data express rhythmic variability. The procedure is implemented in MATLAB. All codes and data are freely available (see **Data Sharing Statement**). The analysis of the cosinor model aims to test two hypotheses: 1) does the public's interest in "learning about gout" vary throughout the year? and 2) does the public's interest vary in a way that manifests increased activity in specific months (and, by extension, seasons) during the year, i.e., over 12 months? An approximate "peak" activity is assigned to the time representing the maximum of the fitted cosinor model). Formal ethics approval was not required since this work comprised publicly available anonymous data and contained no personally identifiable information.

Results

We performed a comprehensive visual inspection to determine countries with adequate data. A final list of 70 countries, **Table 1 Supplementary Material A**, was identified, representing a fair distribution across all continents. The table presents, for all countries, the cosinor parameters associated with the confidence in the season-dependent traffic querying about "gout." Results for all 70 countries are shown in Supplementary Material A. The 70 countries worldwide represent a wide geographical distribution regarding latitude and are reasonably populated. Of the 70 countries considered, 35 (50%) exhibited statistically significant seasonality in gout (

$p_{val} < 0.05$. Typical annual query frequency plots are shown in **Figure 1** for the United States and Australia. Notably, the countries exhibited a reversal in the peak of queries.

Even though English terminology is commonly used, we further elaborated on language-specific terms. We examined searches based on twelve languages: Czech, Danish, Dutch, French, Finnish, German, Greek, Italian, Norwegian, Romanian, Spanish, and Swedish. 30 countries were selected, and all results are depicted in **Supplementary Material D**. When using language-specific terms, of the 30 countries, 27 (77%) exhibited statistically significant seasonality ($p_{val} < 0.05$), **Figure 2**.

Subsequently, we analyzed “gout” queries in all 50 US states (all results are provided in **Supplementary Material B**) and 32 major cities in the US, and 4 in Canada (all results provided in **Supplementary Material C**). The cities in Canada were added to better populate the geographic region up to Alaska. 46 (92%) states exhibited seasonality ($p_{val} \leq 0.05$), with typical results shown in **Figure 1** for the state of Pennsylvania (PA). Of the 36 cities, 33 (92%) exhibited seasonality ($p_{val} \leq 0.05$), **Figure 1**. Inspection of the entirety of the data confirms that the Google Trends data demonstrates robust seasonal patterns. A targeted analysis of areas was performed to obtain a more granular view of the peak of gout-related searches in the US. Further examination of the amplitude of the seasonal oscillations and analysis of the relation between a city’s latitude and the differences (peak to trough) is shown in **Figure 3**.

Finally, and focusing only on the US, we considered searches that either contained descriptions of symptoms without explicitly mentioning the term “gout” or queries that combined the term “gout” with other relevant queries. The terms used were: “burning big toe,” “stiff big toe,” “big toe joint pain,” “pain in big toe,” “sore big toe,” “throbbing toe pain,” “swollen big toe,” “gout doctor,” “gout diabetes,” “gout attack,” “gout cure,” “gout diet,” “gout symptoms,” “gout high blood pressure,” “gout treatment,” “NSAID gout,” “prednisone gout.” The polar plots indicating strong seasonal patterns of behavior are depicted in **Figure 4**.

Discussion

Seasonality is a complex and dynamic concept that extends its influence beyond environmental conditions to shape human behaviors and health. While it is often simplistically attributed to the Earth’s position relative to the Sun—characterized by longer, warmer days in summer and shorter, colder days in winter—the reality is far more intricate. Numerous factors contribute to seasonality, including climate variations, dietary shifts influenced by food availability, fluctuations in activity levels, and the exposome, which encompasses the cumulative environmental exposures experienced over time. Additionally, geographic factors such as latitude, altitude, proximity to bodies of water, and local weather patterns further modulate seasonal characteristics, creating diverse and localized effects.

These seasonal dynamics have profound implications for public behavior, particularly in the realm of health. For instance, patterns in online search behavior offer valuable insights into how individuals respond to seasonal changes in disease prevalence, symptom flare-ups, and preventive health measures. By analyzing these digital behaviors, healthcare professionals and researchers can identify public perceptions, knowledge gaps, and behavioral trends affecting understanding and managing chronic diseases and seasonal health challenges. Integrating environmental seasonality into health communication strategies provides a powerful framework for enhancing disease prevention and management. By aligning interventions and awareness campaigns with seasonal trends, healthcare providers can optimize their efforts to address health challenges and improve outcomes throughout the year.

Internet searches reveal the public’s most common concerns and misconceptions about diseases, symptoms, and treatments. Understanding this data can guide tailored public health campaigns that address specific misconceptions, provide clear and actionable health information, and

promote disease prevention strategies effectively, thereby improving overall health literacy. Monitoring internet searches also plays a critical role in pharmacovigilance. Patients frequently search for information about the side effects of medications. A high volume of searches concerning a specific treatment's adverse effects could signal the need for closer monitoring and potentially guide healthcare providers in offering safer medication alternatives. While Google trends should not be used in isolation, it provides a real-time, scalable source of behavioral information that, when combined with other data, enables the design of more effective, patient-centered interventions [17].

A previous study detected a statistically significant seasonal variation in the Google trends of gout in the US, UK, Canada, Ireland, Australia, and New Zealand. Peaks were observed in the late spring/early summer months for the northern hemisphere countries and November/December for the southern hemisphere countries [18]. Our study took a much broader view. **Figure 1** demonstrates clear seasonal patterns in gout-related search behaviors across different regions, including the United States, Australia, Pennsylvania, and Detroit. The fitted seasonal patterns (red lines) reveal consistent peaks and troughs, indicating that search interest intensifies during certain months, potentially reflecting seasonal exacerbation of gout symptoms. The 95% confidence intervals suggest that these trends are robust, and the highlighted outliers point to occasional spikes in search activity that could correspond to specific events or public health campaigns.

Regional differences in the amplitude and timing of these trends emphasize the influence of localized factors. For example, climate, cultural practices, and healthcare awareness differences may contribute to the observed variations. The divergence between the northern and southern hemispheres, particularly in Australia compared to the U.S., aligns with opposing seasonal cycles due to their geographic positions, reinforcing the importance of climate in modulating gout-related behaviors.

Several countries had limited data. This could be due to several reasons: lack of accessibility to internet resources, lack of access to healthcare or educational background, or living in extreme poverty. Nevertheless, we collected results from 70 countries. Countries including Russia, China, Brazil, and Argentina are geographically vast; therefore, assigning a single descriptor to the entire country is likely missing details. Based on data from the World Bank, as of 2021, in the 70 countries considered in the analysis, on average, 76% of the residents had internet access, with a median of 82%. Therefore, Internet access was, on average, available at significant levels. A complete presentation of the actual recordings is provided in **Supplementary Material A**.

Gout flares are known to be season-dependent and peak during the (relative) late spring-early summer. Although "gout" is a universally recognized keyword for the disease, a behavioral analysis must account for the language-specific nuances of Google search queries. The heatmap in **Figure 2** further elucidates the global patterns of seasonal search interest. The stark contrast between red (peak interest) and green (low interest) months highlights how search behavior correlates with local climate conditions. Hemispheric differences are evident, with northern hemisphere countries like the U.S. and Canada experiencing peaks during colder months, while southern hemisphere nations such as Australia and New Zealand see higher activity during their cooler seasons. This hemispheric contrast underscores a potential link between lower temperatures and increased gout incidence, possibly due to seasonal dietary changes or physiological stressors that exacerbate symptoms. Additionally, the heatmap reflects language-specific searches, which may introduce a layer of complexity related to cultural differences in health-seeking behaviors and internet usage.

According to recent US census data[19] internet use in US households has grown considerably. In 2018, it was reported that 92% of households had at least one type of computer, and 85% had a broadband internet subscription. In addition, smartphone ownership was the most common in 84% of households. Urban households were generally more likely to use computing devices and

have internet subscriptions than rural households. Thus, technology is not a barrier in the US. Despite its size, the US appears more homogeneous compared to continents like Asia or Africa, where the variance in economic development, urbanization, and lifestyle can be more pronounced across different countries or regions within the same country.

Our state-wide analysis revealed seasonal variation, with peaks appearing in the spring/summer seasons (see **Supplementary Material B**); New York, New Jersey, Pennsylvania, Vermont, and others exhibit significant variations. In contrast, Arkansas, Arizona, Florida, Hawaii, Montana, North Dakota, New Mexico, Nevada, and South Dakota exhibit a less pronounced seasonality. This result could be a combination of reasons, from local climate (Arkansas, Florida, Hawaii) to sparseness of data (Montana, North Dakota, New Mexico).

Data from 32 major metropolitan areas in the US and 4 in Canada mirror those obtained from the analysis of US states (see **Supplementary Material C**). Figure 3 explores the relationship between latitude and the amplitude of seasonal variations in gout-related searches. Qualitatively, as we move north, the severity of gout across seasons appears more pronounced. **Figure 3** reveals a general trend of increasing amplitude with higher latitude, as indicated by the red dashed line. This suggests that regions with more pronounced seasonal differences in temperature and climate also exhibit greater seasonal fluctuations in search interest. The implications of this trend are significant. Higher latitudes experience more extreme temperature variations, which may influence behaviors and physiological factors associated with gout exacerbation. For instance, colder weather might trigger flare-ups, prompting increased online searches for symptoms and treatments. Alternatively, dietary patterns that shift with seasons, such as higher purine intake during winter holidays, could be contributing factors.

The polar plots in **Figure 4** offer a detailed categorization of seasonal trends in gout-related online searches, grouped into three main areas: symptoms, treatments, and broader management strategies. Symptom-related searches, such as "NSAIDGout" and "PrednisoneGout," exhibit parallel seasonal patterns, suggesting these searches are a reactive behavior to acute gout flares. In addition, searches for more specific gout-related terms such as "gout attack," "gout flare," "gout doctor," "gout cure," "gout treatment," also show strong seasonality, consistent with the documented spring-summer exacerbation of gout symptoms.

Interestingly, the likelihood of seasonal variation in treatment-related terms like "prednisone" and "NSAID" depends on their context. When these terms are searched in isolation, no significant seasonal variation is observed (p-values = 0.5 and 0.3, respectively). However, their seasonal relevance becomes apparent when coupled with "gout," underscoring how public behavior, as captured by Google Trends, can reveal nuanced insights into the seasonality of health conditions. In contrast, searches associated with broader management strategies, such as "goutDiet" and "goutDiabetes," show a more consistent baseline interest throughout the year, with less pronounced seasonality. This contrast highlights the multifactorial nature of health-seeking behaviors, where acute needs drive seasonal trends, while chronic management concerns maintain steady interest over time.

The study confirms the seasonality of gout-related search behavior, demonstrating distinct seasonal patterns in public interest as reflected in Google search queries. These patterns align closely with the clinical seasonality of gout flares, peaking in late spring to early summer in the Northern Hemisphere, while the Southern Hemisphere shows reversed trends due to opposing seasonal cycles. This geographic variability in gout-related search interest highlights the influence of climate and geography on public health behavior. Furthermore, analyzing language-specific queries reinforced the observed seasonal patterns, emphasizing the need to account for linguistic diversity in infodemiology studies. Notably, searches for gout symptoms using generic terms such as "burning big toe" or "swollen big toe," without explicitly mentioning "gout," followed similar seasonal trends, underscoring the alignment between public health information-seeking behavior and the clinical characteristics of the disease.

Limitations and Ethical Dilemmas: The integration of digital epidemiology with traditional health data offers a powerful tool for understanding public health trends, improving disease management, and optimizing health communication strategies. However, these results are based on search behaviors, which may not directly translate to clinical incidence or severity of gout. Factors such as access to the internet, health literacy, and cultural attitudes toward seeking medical information online could influence the observed trends. Not all searches reflect a medical issue; some are driven by curiosity or misinformation. Moreover, there is an inherent bias in internet use, with disparities in access across different socioeconomic and demographic groups. Recording and analyzing human behavior undoubtedly provides significant potential advantages, enabling a better understanding of public interest and emerging needs. However, several dangers and ethical concerns lurk, and possible privacy issues can arise. Newer technologies, primarily associated with wearable devices, promise to revolutionize how we understand human behavior. Therefore, while the benefits are plentiful, we must consider the negative implications.

Google Trends emerges as a valuable tool for monitoring public interest in chronic diseases like gout, providing real-time, scalable insights. While it should not replace traditional epidemiological methods, it serves as a complementary resource that can inform health communication strategies and disease management efforts. This research highlights the seasonal nature of gout-related public interest while capturing the geographic and linguistic variations that shape health-seeking behaviors. The findings illustrate how infodemiology can enhance our understanding of disease dynamics and contribute to improving health outcomes.

Understanding the seasonality of inflammatory diseases like gout presents significant opportunities for enhancing patient care and public health planning. By anticipating seasonal patterns, healthcare providers can implement targeted preventive measures, adjust medications proactively, and promote lifestyle interventions tailored to the times of highest risk. From a broader public health perspective, the strong seasonal component in gout-related online search behavior, shaped by geographic and climatic factors, has important implications for designing timely and effective interventions. For instance, awareness campaigns and preventive measures can be strategically deployed during seasonal peaks to maximize impact. Future research should explore other seasonal and geographic factors, such as dietary trends and socioeconomic influences, providing a more comprehensive understanding of the observed patterns.

Data Sharing Statement: This study's data and computer codes are available on GitHub. These include raw data, MATLAB code for the analysis, and comprehensive results (**Supplementary Material A, B, C, and D**). All are accessible following the link: <https://github.com/IPAndroulakis/Infodemiology-of-Gout>. The raw data contains anonymized, normalized monthly frequency of queries as reported in Google Trends[16].

Declaration of competing interests: Ioannis P. Androulakis has no competing interests to report.

Naomi Schlesinger reports a relationship with Amgen Inc that includes: consulting or advisory; Naomi Schlesinger reports a relationship with Novartis that includes: consulting or advisory; with Protalix Biotherapeutics that includes: consulting or advisory; with SOBI that includes: consulting or advisory; with Olatec that includes: consulting or advisory; with Shanton that includes: consulting or advisory; with Arthroxi that includes: consulting or advisory; with LG Chem Ltd that includes: consulting or advisory; with Avalo Therapeutics Inc that includes: consulting or advisory; with SCILEX Pharmaceuticals that includes: consulting or advisory.

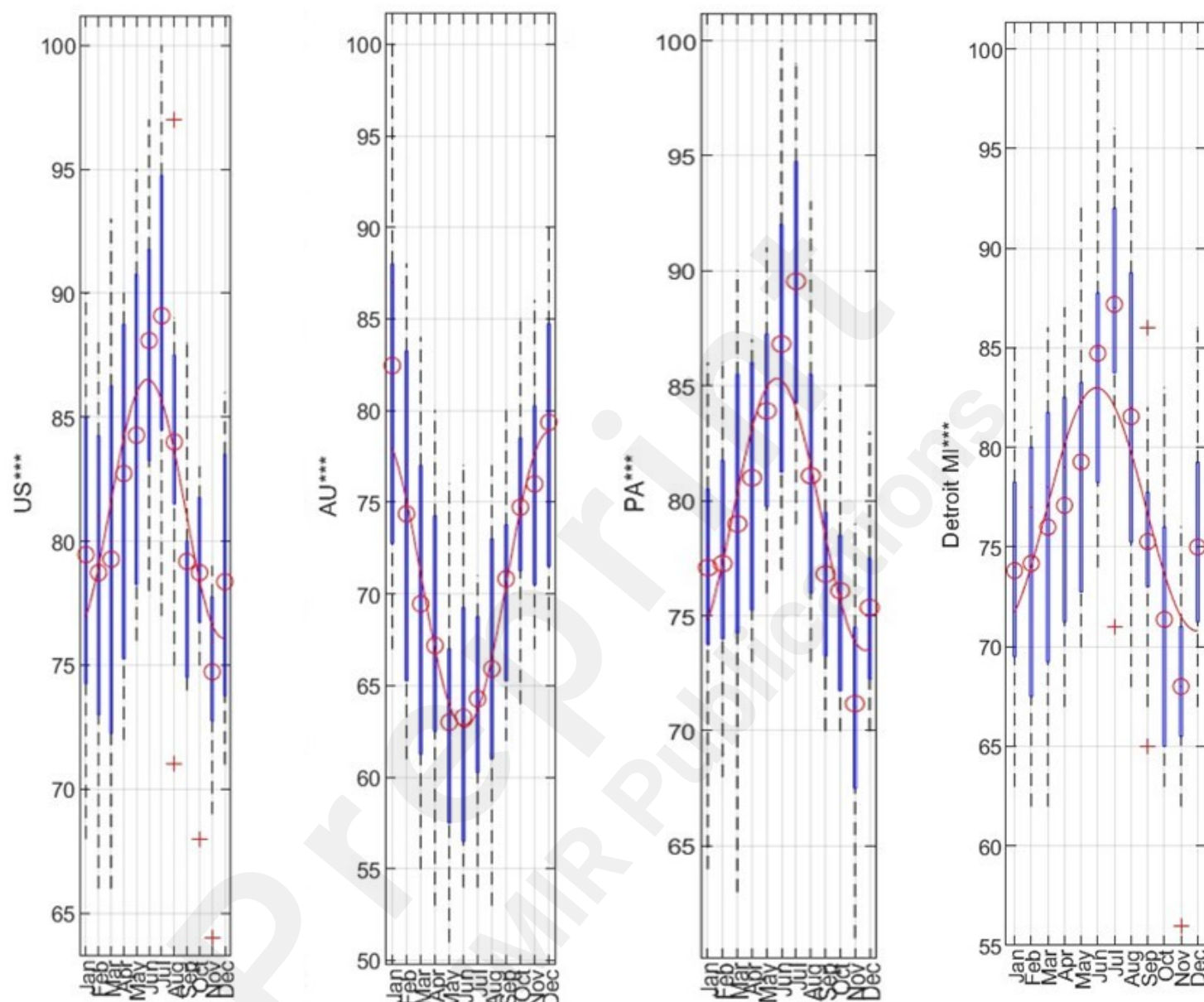


Figure 1: Seasonal Variations in Gout Search Interest Across Regions: Line plots with 95% confidence intervals (blue bars) showing monthly trends in search activity for gout-related terms in the United States (US), Australia (AU), Pennsylvania (PA), and Detroit, MI. Red lines represent fitted seasonal patterns, while red markers highlight outliers. Differences between regions suggest localized seasonal effects on search behavior. See **Supplementary Matrial A, B, C** for complete results.

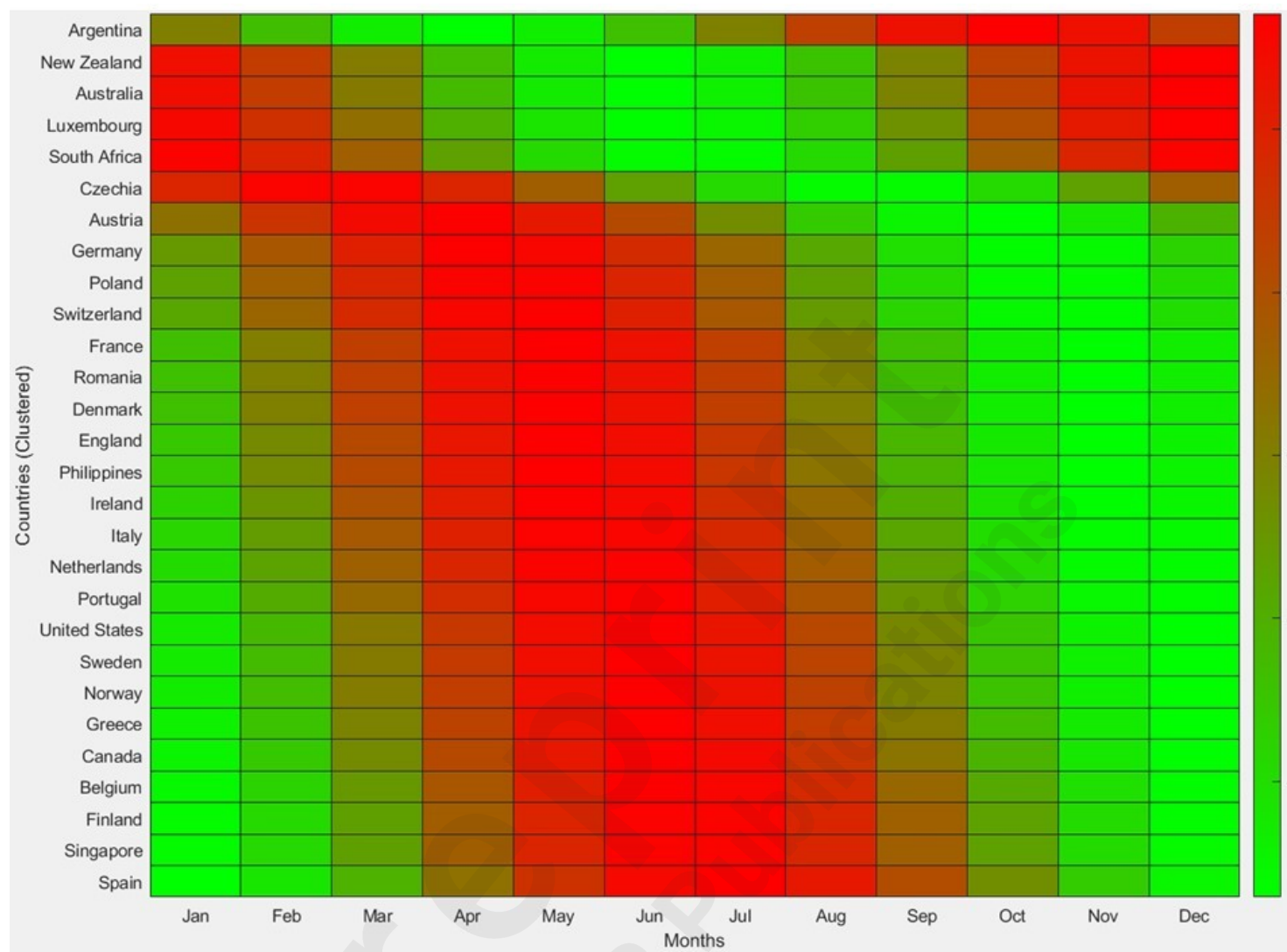


Figure 2: Seasonal Heatmap of Gout-Related Search Trends Across Countries: Heatmap showing monthly variations in search interest across countries. Red indicates peak interest, green indicates low interest. The searches reflect interest in the keyword 'gout,' translated into language-specific terms, with each country using its dominant language. Distinct seasonal patterns are visible, with variations between hemispheres reflecting local climate and seasonal factors. Detailed results in **Supplementary Material D**.

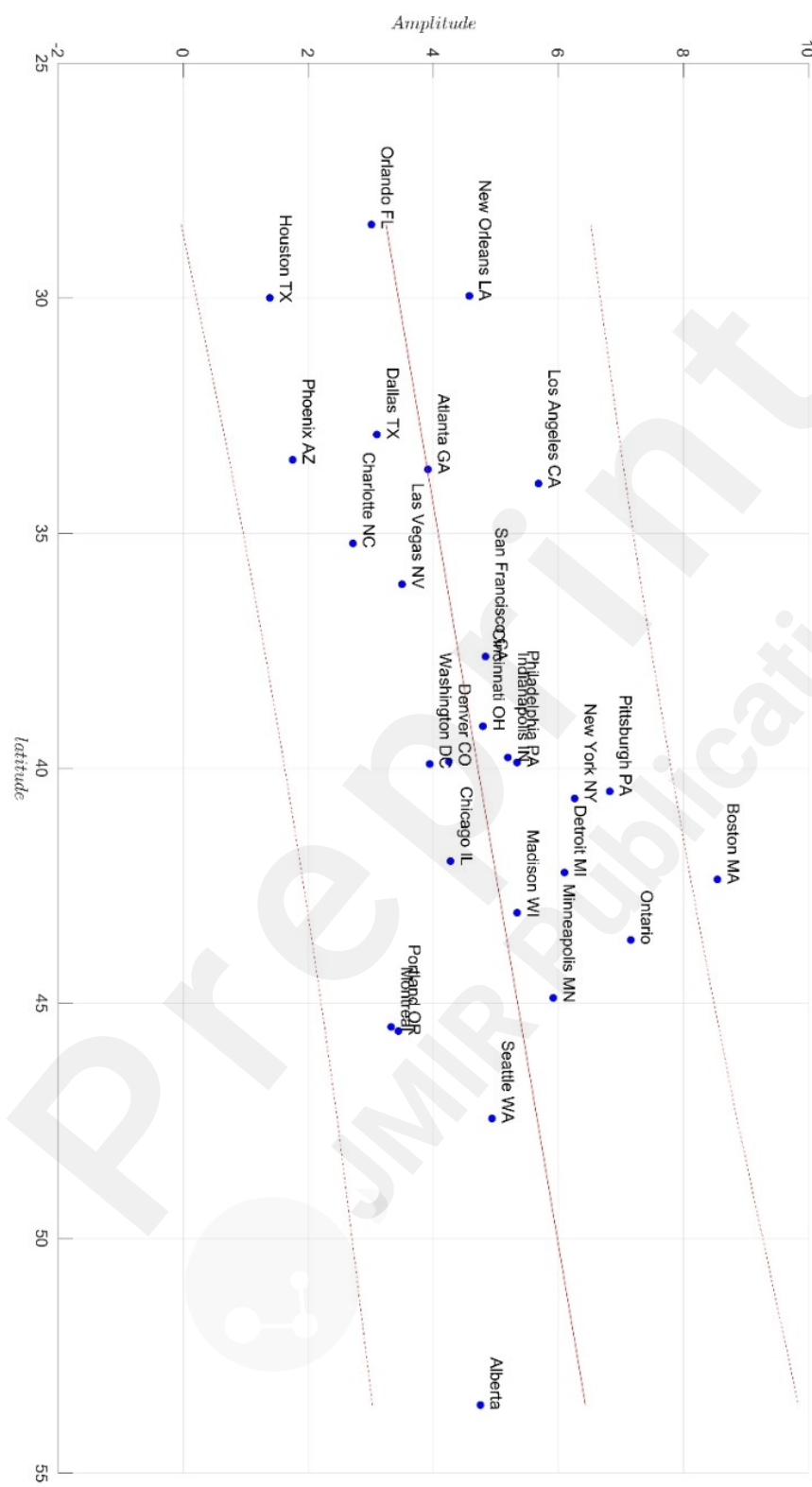


Figure 3: Geographic Variation in Amplitude of Gout-Related Search Trends: Scatter plot showing the relationship between latitude and the amplitude of seasonal search patterns for gout-related terms across various cities in North America. Each blue dot represents a city, with higher amplitudes indicating greater seasonal variation. The red dashed line illustrates a general trend, suggesting a potential relationship between latitude and the degree of seasonality in search interest. Detailed results in **Supplementary Material C**.

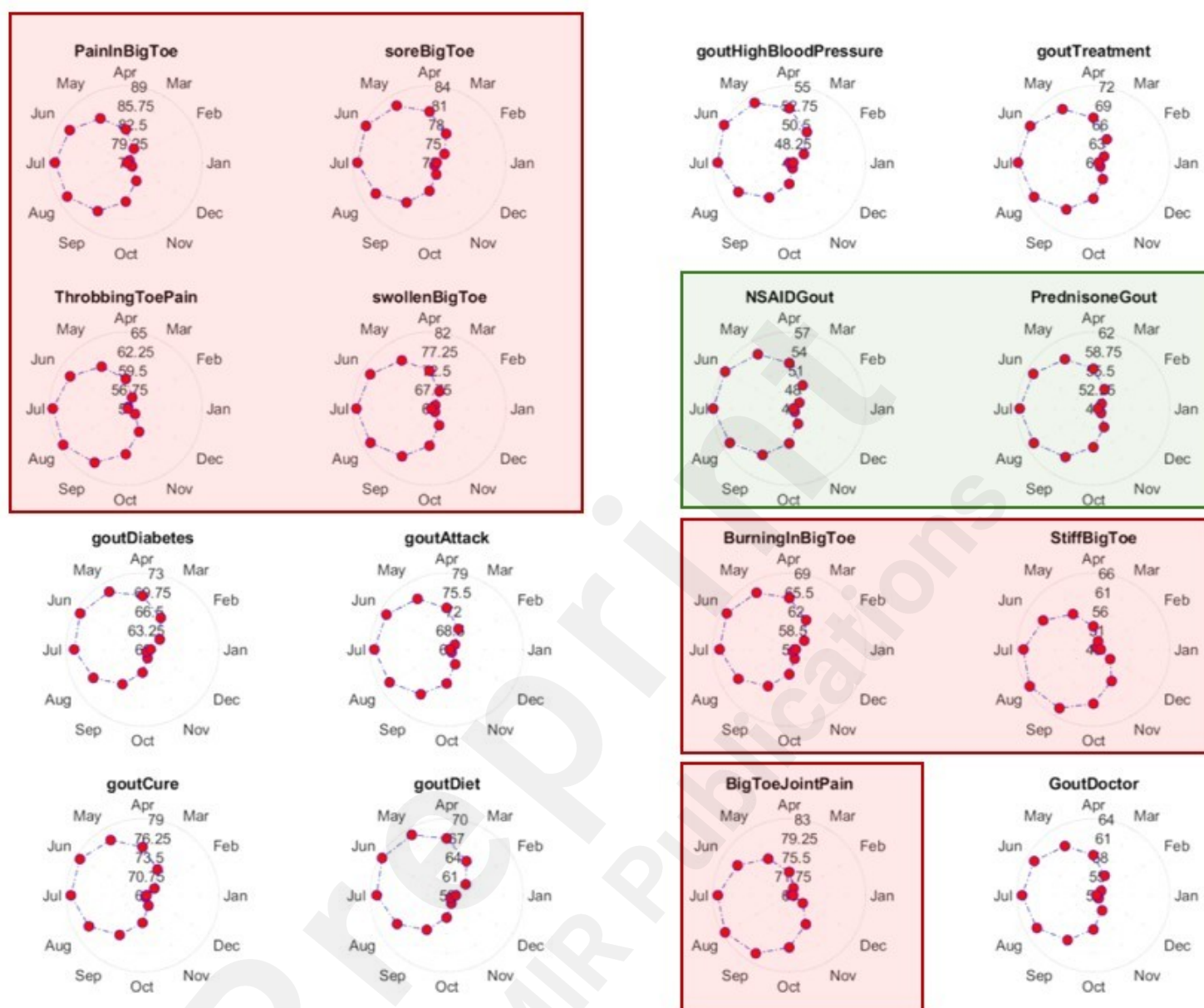


Figure 4: "Seasonal Trends in Gout-Related Searches: Polar plots illustrating monthly patterns in search interest for various gout-related terms. Red-shaded panels focus on symptoms (e.g., 'PainInBigToe', 'soreBigToe', 'ThrobbingToePain'), green-shaded panels highlight treatments (e.g., 'NSAIDGout', 'PrednisoneGout'), and other panels represent search trends for conditions and management strategies (e.g., 'goutDiabetes', 'goutDiet'). Peaks in search activity suggest seasonal variations in interest or incidence."

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Supplementary Files

Figures

Seasonal Variations in Gout Search Interest Across Regions: Line plots with 95% confidence intervals (blue bars) showing monthly trends in search activity for gout-related terms in the United States (US), Australia (AU), Pennsylvania (PA), and Detroit, MI. Red lines represent fitted seasonal patterns, while red markers highlight outliers. Differences between regions suggest localized seasonal effects on search behavior. See Supplementary Matrial A, B, C for complete results.

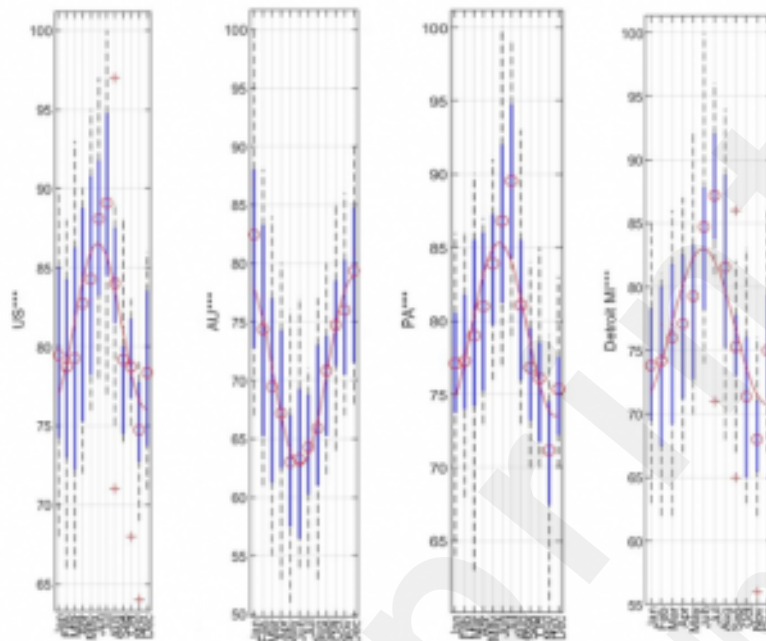


Figure 1: Seasonal Variations in Gout Search Interest Across Regions: Line plots with 95% confidence intervals (blue bars) showing monthly trends in search activity for gout-related terms in the United States (US), Australia (AU), Pennsylvania (PA), and Detroit, MI. Red lines represent fitted seasonal patterns, while red markers highlight outliers. Differences between regions suggest localized seasonal effects on search behavior. See **Supplementary Matrial A, B, C** for complete results.

Seasonal Heatmap of Gout-Related Search Trends Across Countries: Heatmap showing monthly variations in search interest across countries. Red indicates peak interest, green indicates low interest. The searches reflect interest in the keyword 'gout,' translated into language-specific terms, with each country using its dominant language. Distinct seasonal patterns are visible, with variations between hemispheres reflecting local climate and seasonal factors. Detailed results are in Supplementary Material D.

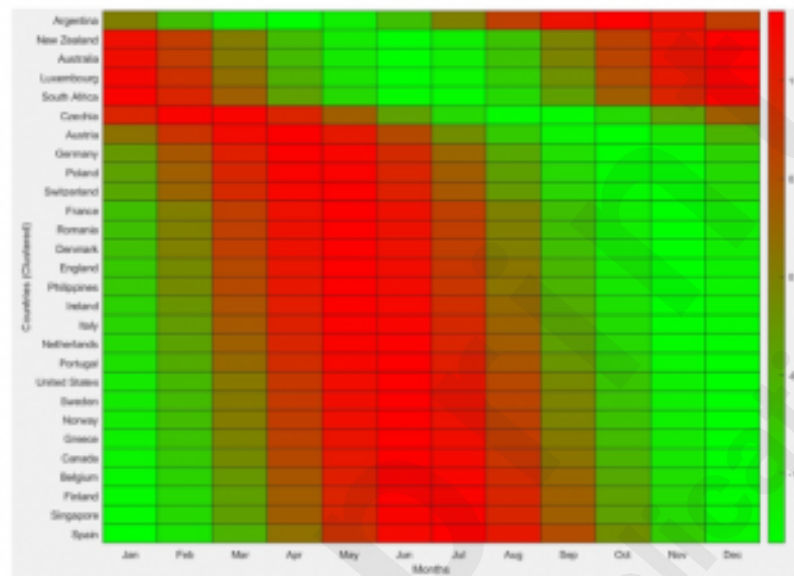


Figure 2: Seasonal Heatmap of Gout-Related Search Trends Across Countries: Heatmap showing monthly variations in search interest across countries. Red indicates peak interest, green indicates low interest. The searches reflect interest in the keyword 'gout,' translated into language-specific terms, with each country using its dominant language. Distinct seasonal patterns are visible, with variations between hemispheres reflecting local climate and seasonal factors. Detailed results in **Supplementary Material D**

Geographic Variation in Amplitude of Gout-Related Search Trends: Scatter plot showing the relationship between latitude and the amplitude of seasonal search patterns for gout-related terms across various cities in North America. Each blue dot represents a city, with higher amplitudes indicating greater seasonal variation. The red dashed line illustrates a general trend, suggesting a potential relationship between latitude and the degree of seasonality in search interest. Detailed results in Supplementary Material C.



Figure 3: Geographic Variation in Amplitude of Gout-Related Search Trends: Scatter plot showing the relationship between latitude and the amplitude of seasonal search patterns for gout-related terms across various cities in North America. Each blue dot represents a city, with higher amplitudes indicating greater seasonal variation. The red dashed line illustrates a general trend, suggesting a potential relationship between latitude and the degree of seasonality in search interest. Detailed results in Supplementary Material C.

Seasonal Trends in Gout-Related Searches: Polar plots illustrating monthly patterns in search interest for various gout-related terms. Red-shaded panels focus on symptoms (e.g., 'PainInBigToe', 'soreBigToe', 'ThrobbingToePain'), green-shaded panels highlight treatments (e.g., 'NSAIDGout', 'PrednisoneGout'), and other panels represent search trends for conditions and management strategies (e.g., 'goutDiabetes', 'goutDiet'). Peaks in search activity suggest seasonal variations in interest or incidence.

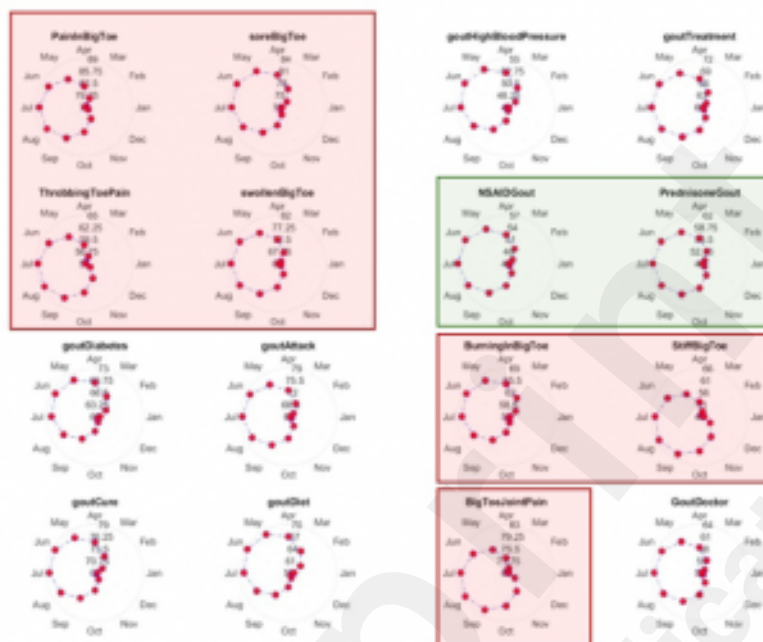


Figure 4: "Seasonal Trends in Gout-Related Searches: Polar plots illustrating monthly patterns in search interest for various gout-related terms. Red-shaded panels focus on symptoms (e.g., 'PainInBigToe', 'soreBigToe', 'ThrobbingToePain'), green-shaded panels highlight treatments (e.g., 'NSAIDGout', 'PrednisoneGout'), and other panels represent search trends for conditions and management strategies (e.g., 'goutDiabetes', 'goutDiet'). Peaks in search activity suggest seasonal variations in interest or incidence."