SKIN

BRIEF ARTICLE

The Association Between Internet Search Patterns and Scabies Incidence Across the United States

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ABSTRACT

Background: Scabies, a contagious skin infestation caused by Sarcoptes scabiei, is a significant public health concern[1]. Traditional surveillance methods for scabies suffer from time lag and incomplete data, hindering early detection and response[5]. The widespread use of the internet and search engines, such as Google™, offer new opportunities for alternative surveillance approaches.
Objective: This study aimed to explore the association between scabies search volumes on Google Trends™ (GTs) and scabies incidence at the state level across the United States.
Methods: GTs data for each U.S. state and scabies incidence from 2011 to 2019 were analyzed for summary statistics and association.
Results: The mean Spearman correlation coefficient for the period of 2011-2019 indicated a strong positive correlation between GTs RSVs for “scabies” and the incidence of scabies in the United States. Using an unpaired t-test, this correlation was found to be statistically significant.
Conclusions: In resource-scarce environments where access to care is a common barrier, healthcare providers and departments can leverage this information to effectively target populations and employ resources for scabies prevention and treatment. Analyzing search engine term patterns can enhance our understanding of people's behavior when they suspect a scabies infestation.

INTRODUCTION

Scabies is a common contagious skin infestation caused by *Sarcoptes scabiei* that results in intense itching[1]. This parasitic infestation affects millions worldwide and leads to considerable morbidity[2]. Recognized by the World Health Organization (WHO) as one of the most important neglected tropical diseases, scabies rapidly spreads and can remain asymptomatic but contagious for about 4-8 weeks[3, 4]. Therefore, it is important for providers and health agencies to engage in efficient surveillance to initiate timely interventions and treatments. Traditional surveillance methods often suffer from time lag and incomplete data[5]. This can hinder early detection and response, potentially exacerbating the outbreak and leading to worse patient outcomes.

The widespread use of the internet has opened new avenues for alternative surveillance approaches. Google™, the most widely used search engine, offers valuable insights into the search patterns and interests of users through its program Google

Trends™ (GT)[6]. Previous research has demonstrated the utility of this resource in identifying and tracking the prevalence and transmission of diseases[7, 8]. It's specific role in monitoring scabies outbreaks within the United States remains unexplored.

By analyzing GTs data and scabies incidence from 2011 to 2019, this study seeks to establish an association between scabies search volumes and scabies incidence in the U.S. states. We aim to highlight the role of internet search activity in guiding and supplementing U.S. public health scabies surveillance, especially for clinicians who are able to rapidly access this information at no cost.

METHODS

Data Collection

The GBD Results tool was employed for this study[9]. The following search criteria was used as input: Cause of death or injury (GBD Estimate), Incidence (Measure), Rate per 100k (Metric), Scabies (Cause), Select all of United States of America (Location), All ages (Age), and Both (Sex). The year was changed by one-year increments between 2011 and 2019 with each search. Incidence rates of scabies per U.S. state per year were obtained.

Data from each yearly increment from 2011 to 2019 were extracted from GT[10]. Relative search volume (RSV) values were obtained in each state for the word "scabies" for each year. Control RSV values were also obtained in each state using the term that corresponded to that year for each year. For example, the search term "2011" was used as the control term for the year 2011. RSV values of each state represent search interest relative to the highest state's popularity. These values range from 0 to 100, with 100 signifying peak popularity and 0 denoting a complete absence of interest. For example, if state A has the highest number of searches of the term, it would have an RSV of 100 and other states would be compared relative to state A to determine their RSV.

Statistical Analysis

Summary statistics of each collected variable were assessed. Spearman's rank correlation coefficients were used to evaluate the association of RSVs of "scabies" and incidence of scabies in each state. Spearman's rank correlation coefficients were also used to assess the relationship between the control RSVs of each year and incidence of scabies in each state. These values were assessed for statistical significance using an unpaired t-test calculated using GraphPad by Dotmatics™, where $\alpha = 0.05$.

RESULTS

States with the highest RSVs and highest incidences were evaluated for each year between 2012 to 2019 (**Table 1**). West Virginia was the state with the highest "scabies" RSV (100) for six out of nine of the years and ranked as the state with the 6th highest incidence of scabies on average for those years. Kentucky had the highest incidence of scabies for eight out of nine of the years and ranked as the state with the 4th highest RSV value on average for those years.

The association between RSVs for the search term "scabies" and incidence of scabies in each state was evaluated using Spearman's rank correlation coefficients. The spearman's rank correlation coefficient for each year exhibited a positive association

Table 1. U.S. states with the highest Google Trends™ relative search volumes of 100 for each year between 2012 to 2019 and the corresponding scabies incidence (rate per 100k). Additionally, U.S states with the highest scabies incidence, the corresponding incidence of scabies (rate per 100k), and the relative search volumes (out of 100) per year between 2012 and 2019.

Year	RSV of 100	Incidence	Highest Incidence	Incidence	Relative RSV
2012	West Virginia	555.35	Kentucky	613.38	80
2013	West Virginia	551.95	Kentucky	608.71	84
2014	Mississippi	513.74	Kentucky	603.56	81
2015	West Virginia	545.41	Kentucky	598.32	89
2016	West Virginia	545.53	Kentucky	594.36	85
2017	Mississippi	549.17	Kentucky	586.59	87
2018	West Virginia	523.97	Kentucky	567.47	79
2019	West Virginia	487.48	Mississippi	541.07	88

Table 2. Mean spearman's rank correlation coefficients calculated using Google Trends™ relative search volumes of 'scabies' and scabies incidence and mean scabies incidence (rate per 100k) in the United States for each year between 2012 to 2019.

Year	Correlation Coefficient	Mean Incidence
2012	0.806	380.77
2013	0.848	378.24
2014	0.812	375.90
2015	0.803	374.15
2016	0.821	378.90
2017	0.738	385.07
2018	0.735	384.25
2019	0.723	379.35

between RSV of "scabies" and incidence of scabies (**Table 2**). The mean spearman's rank correlation coefficient for the period of 2011-2019 was 0.790 (SD=0.045). This indicates a strong positive correlation between the GTs RSVs for "scabies" and the incidence of scabies in the United States.

An unpaired t-test comparing the control searches to the "scabies" searches across all years indicated an extremely statistically significant difference (t=24.26, df=16, standard error of difference = 0.025). The two-tailed p-value was less than 0.0001, suggesting the association between the "scabies" RSVs and scabies incidence was significantly stronger than the relationship between control searches and scabies incidence in each state.

DISCUSSION

This study aimed to evaluate the relationship between the RSV of "scabies" via GTs, and the incidence of scabies in each U.S. state. Our team found Kentucky had the highest scabies incidence for most years between 2012 and 2019, while West Virginia had the highest RSV for most years between 2012 and 2019. One possible explanation for this finding includes the higher poverty levels and rural area observed in West Virginia[11]. As these areas may be lacking in dermatologic resources and facilities, individuals from West Virginia may be relying heavier on the internet to obtain medical information about this condition compared to other states with slightly higher incidences, such as Kentucky. This suggests that states with higher RSV scores for scabies should be assessed for their access to dermatologic resources to determine and potentially minimize the disparities impacting their health.

Our findings also illustrate a significant correlation between internet searches for "scabies" and incidence of scabies infestations. This indicates that Google Trends™ could be a helpful tool, especially for physicians who may not have access to up-to-date information, in identifying scabies outbreaks and guiding differential diagnoses. Further, it could play a key role in health organizations for guiding interventions to mitigate spread.

Our analysis is limited by the constraints intrinsic to GT parameters in that it only provides a relative search volume (RSV) index. Without absolute search volumes, we are only able to compare spikes in searches relative to other areas in the United States instead of the actual numerical value of the search term itself. However, this still serves as important information for informing the allocation of resources within the United States.

CONCLUSION

Utilizing search engine data, such as those provided by GTs, to identify and monitor outbreaks could provide a cost-effective avenue to address the limitations of current surveillance systems.

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References:
1. Tarbox M, Walker K, Tan M. Scabies. JAMA. 2018;320(6):612. doi:10.1001/jama.2018.7480
2. Banerji, A., & Canadian Paediatric Society, First Nations, Inuit and Métis Health Committee (2015).

Scabies. Paediatrics & child health, 20(7), 395–402. https://doi.org/10.1093/pch/20.7.395
3. World Health Organisation: Scabies and other ectoparasites. 2020.
4. Centers for Disease Control and Prevention. (2020, September 1). CDC - scabies - general information - frequently asked questions (faqs). Centers for Disease Control and Prevention. https://www.cdc.gov/parasites/scabies/gen_info/faqs.html#:~:text=If%20a%20person%20has%20never,%2D4%20days)%20after%20exposure.
5. Murray, J., & Cohen, A. L. (2017). Infectious Disease Surveillance. International Encyclopedia of Public Health, 222–229. https://doi.org/10.1016/B978-0-12-803678-5.00517-8
6. Bleu, N. (2022, September 30). 19+ crucial search engine statistics for 2023 (market share, usage, & demographics). Startup Bonsai. https://startupbonsai.com/search-engine-statistics/
7. Simonart, T., Lam Hoai, X. L., & De Maertelaer, V. (2021). Epidemiologic evolution of common cutaneous infestations and arthropod bites: A Google Trends analysis. JAAD international, 5, 69–75. https://doi.org/10.1016/j.jdin.2021.08.003
8. Amusa, L. B., Twinomurinzi, H., & Okonkwo, C. W. (2022). Modeling COVID-19 incidence with Google Trends. Frontiers in research metrics and analytics, 7, 1003972. https://doi.org/10.3389/frma.2022.1003972
9. Global Burden of Disease Collaborative Network. (2020). Global Burden of Disease Study 2019 (GBD 2019) Results. Seattle, United States: Institute for Health Metrics and Evaluation (IHME). Retrieved from https://vizhub.healthdata.org/gbd-results/
10. Google. Google Trends. http://www.google.com/trends. Accessed June 1, 2023.
11. Most Rural States. Most rural states [updated September 2022]. (n.d.). https://worldpopulationreview.com/state-rankings/most-rural-states.