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Analyzing the Association of Google Trends and Temperature with Rocky Mountain Spotted Fever in the United States 2004-2015

David Sun

ABSTRACT

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INTRODUCTION: Rocky Mountain Spotted Fever (RMSF) is a vector-borne disease spread through infected ticks. Climate influences survival and distribution of ticks which as an effect on exposure with humans. Since 2000, the incidence has increased from 1.7 cases per million person-years to 14.3 cases per million person-years in 2012. Around this time, Google was founded has become the premiere search engine in the United States market with the number of unique monthly visitors surpassing one billion for the first time in May 2011. Google Trends is a public tool provided by Google Inc. that shows how often a search term is entered relative to total-search volume across various regions, tracking data since Google's public offering release in 2004.

AIM: This study examines the association between Google Trends, temperature, and onset cases of Rocky Mountain Spotted Fever in the United States from 2004-2015.

METHODS: This is a retrospective cross-sectional study; data was obtained from the National Notifiable Disease Surveillance System (NNDSS), National Oceanic and Atmosphere Administration (NOAA), and Google Trends. Thirty-four states were examined based on Spotted Fever Rickettsiosis (SFR) incidence in 2014 according to the Centers for Disease Control and Prevention (CDC). The average minimum temperature, average temperature, and average maximum temperature for the 34 states was collected from the NOAA website. Google Trends data was based on the search term "Rocky Mountain Spotted Fever". SAS was used to conduct simple and multiple regression analysis to examine the association between SFR onset cases, temperature, and Google Trend's data.

RESULTS: From 2004-2015, a total of 25,993 onset cases were recorded across 34 states. North Carolina (5777 onset cases) had the most recorded while Connecticut (2 onset cases) had the least recorded. Statistical significance was measured at $p \leq 0.05$. When examining the United States, the model (onset case = Interest Over Time) was statistically significant, the predictor Interest Over Time explained 52.62% of the variance ($R^2 = 0.5262$, $F_{1,143}=157.69$, $p < 0.0001$). Interest Over Time was also found to be statistically significant ($\beta = 6.57$, $t_1 = 12.56$, $p < 0.0001$). When examining data at a state level, average temperature, as a predictor for onset cases, was statistically significant across 31 out of 34 states (31/34). Average minimum temperature (31/34) and average maximum temperature (31/34) also had the same statistical significant ratio as average temperature. Google trends was statistically significant for 14 out of 34 states (14/34). Only 5 out of 34 states had both variables as statistically significant when measured as predictors.

CONCLUSION: The results from this study shows that Google Trends has at best modest reliability in determining the epidemiology of Rocky Mountain Spotted Fever. Temperature does show an association to onset cases, but we must keep in mind that temperature primarily describes the association for exposure to infection rather than actual onset cases. Overall, it is unclear what kind of influence Google Trends has and require further studies.

ANALYZING THE ASSOCIATION OF GOOGLE TRENDS DATA AND TEMPERATURE WITH ROCKY MOUNTAIN SPOTTED FEVER IN THE UNITED STATES 2004-2015

by

DAVID SUN

M.P.H., GEORGIA STATE UNIVERSITY
B.S., EMORY UNIVERSITY

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30303

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Analyzing the Association of Google Trends Data and Temperature with Rocky Mountain Spotted Fever in the United States 2004-2015

by

David Sun

Approved:

Dr. Gerardo Chowell, PhD
Committee Chair

Naomi Drexler, MPH
Committee Member

Date: April 30, 2018

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Author's Statement Page

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David Sun
Signature of Author

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INTRODUCTION

1.1 Background

Rocky Mountain spotted fever (RMSF) is one of the most lethal and frequently reported tick diseases in the United States.[1] Named after Howard Taylor Ricketts, a pathologist who discovered the tick to be the main vector of transmission, RMSF is caused by the bacterium *Rickettsia rickettsii* and originated in the Rocky Mountain region, affecting a large majority of the western hemisphere.[2,6,43] The disease is mainly spread through two tick species in the North America region: the Rocky Mountain wood tick *Dermacentor andersoni* in western North America and the common American dog tick *Dermacentor variabilis* in the eastern and southern United States.[44] More recently the brown dog tick *Rhipicephalus sanguineus* has been associated with the infection in the southwestern United States, particularly Arizona.[44]

Early signs and symptoms begins with fever, headache, rash, eschar, headache, myalgia, anemia, thrombocytopenia, or any hepatic transaminase elevation.[3,14] A macular or maculopapular rash appears in 80% of patients 4 to 7 days following onset of the disease.[14] Disease onset typically follows one week after a tick bite.[14] Diagnosis of RMSF can be difficult as early signs and symptoms are nonspecific or mimic other diseases.[45] In more severe cases, other potentially life-threatening outcomes include respiratory distress, renal failures, necrosis, and death.[4] Untreated case fatalities rates (CFRs) for RMSF may be around 20-25%; untreated cases can lead to death 8 days after onset of symptoms, however early detection and treatment can greatly decrease risk of severe illness and death.[5] The CFR for RMSF was 1-10% in the United States from 1950-2000 and has remained under 1% from 2001 to 2013.[27] Doxycycline is the antibiotic treatment of choice for adults and children of all ages and delays in the administration of doxycycline has been shown to increase the chances of a fatal outcome.[7,22,23]

From 2008-2013, children age 9 or younger are the highest reported CFR group despite the lowest reported incidence rate among age groups.[5]

RMSF has been a nationally notifiable disease since the 1920s.[8,27] Starting in 2010, the Council of State Territorial Epidemiologist (CSTE) renamed RMSF to Spotted Fever Rickettsiosis (SFR) to include RMSF and other Rickettsial diseases as part of its definition due to the inability of serological laboratory testing to distinguish specific Rickettsial species.[5,26,47] This new case definition for SFR was added January 1, 2010 and captured cases of RMSF, R. parkeri rickettsiosis, Pacific Coast tick fever, and rickettsialpox.[8,47] The incidence of SFR (the number of SFR cases for every million person-years) increased from 1.7 cases per million person-years in 2000 to over 11 cases per million person-years in 2014, reaching an all-time high of 14.2 cases per million person in 2012.[8] Although SFR cases have been reported throughout the contiguous United States, from 2000-2012 five states in particular (North Carolina, Oklahoma, Arkansas, Tennessee, and Missouri) account for over 60% of SFR cases.[8,21]

The current 2010 SFR case definition defines clinical criteria for SFR as any reported fever and one or more of the following symptoms:[14]

- Rash
- Eschar
- Headache
- Myalgia
- Anemia
- Thrombocytopenia
- Any hepatic transaminase elevation

Laboratory criteria for testing include: a blood sample prior to antibiotic treatment to be detected by polymerase chain reaction (PCR), a skin biopsy sample for immunohistochemical methods (IHC), or a paired acute and convalescent serum sample for serology immunofluorescence assay (IFA) testing.[14] For surveillance purposes, confirmation through laboratory testing must include:[14]

- Serological evidence of a fourfold change in immunoglobin G (IgG)-specific antibody titer reactive to spotted fever group antigen by IFA testing **OR**
- Detection of a spotted fever group DNA via PCR testing **OR**
- Detection of a spotted fever group antigen in a biopsy or autopsy specimen by IHC **OR**
- Isolation of a spotted fever group from a clinical specimen through cell culture

Exposure is defined as potentially being in a tick habitat within the past 14 days before the onset of symptoms, however a history of tick bite is not required.[14]

Seasonal trends also influence reported cases in the United States. Because of the tick's life cycle and increased out-doors human activities, the majority of RMSF and other tick diseases happen during the summer months.[5,8,31] Temperature appears to play a role in tick activity with warmer temperatures leading to longer periods of tick feeding activity; a higher increase in reported onset cases occur in the warmer, southeast United States regions.[5] Host distribution and habitat, affected by climate, also influence tick abundance in the United States.[9] Arizona and California have less characteristic seasonal trends when compared to other states and could be the result of year-round moderate temperatures.[5] Studies have also found correlations between precipitation and tick abudance.[9] Figure 3 shows a breakdown of reported onset cases to NNDSS from 2004-2015.

Founded in 1998, Google is an American technology company that has gained global distinction. Specializing in many internet-related services and products, it is perhaps most famously known for its internet search engine. Since its inception, Google has become the premier search engine on the internet, handling over 3.5 billion searches a day.[10] As of February 2016, Google is the most used search engine with a 64% market share in the United States.[12] Google Trends was launched in 2006 as a search analysis tool using Google search data. By taking a sample of Google search data, Google Trends is able to illustrate a search term's interest over time (since 2004), where it's most searched in the world, and what else people search in conjunction with it.[13] Data is normalized and indexed from 0 to 100, where 100 is the maximum search interest for a search term's time and location selected.[13] Google Trends can be a powerful tool that provides an insight into the interest of a population and their reaction to certain events.[13]

1.2 Purpose of the Study

With the rapid growth of digital data sources, "digital epidemiology" has steadily grown the past few years with a few studies already examining this field. The purpose of this study is to perform a retrospective cross-sectional study using data from the 2004-2015 National Notifiable Disease Surveillance System (NNDSS), a nationwide collaboration that shares notifiable disease related information, to examine the association between onset cases of SFR, temperature, and Google Trends data using the search term "Rocky Mountain spotted fever". This study will evaluate how well Google Trends correlate with actual reported data and if it can be a precursor to when onset cases are reported. This study aims to further examine the association of digital data with epidemiological trends.

1.3 Research Questions

1. Is there an association between Google Trends search data with onset cases of SFR?

2. Is it possible for Google Trends to act as a precursor in determining peaks of onset case of SFR?

3. Does adding temperature data with Google Trends data help with the predictability of onset case occurrences?

4. Due to the changes in the SFG case definition in 2008, would analyzing onset cases after this date improve the predictability when using average temperature and Google Trends as predictors?

LITERATURE REVIEW

2.1 RMSF Case Definition History

According to the Council of State Territorial Epidemiologist (CSTE), a case definition is a set of criteria defining a disease for public health surveillance.[15] This uniformity when defining disease cases allows public health officials across different jurisdictions to consistently report and count cases.[15] However case definitions are not used by health care providers to make clinical diagnoses or determining a patient's health needs.[15] While reportable conditions for diseases differ between states, the CTSE recommends that state health departments report selected diseases' by the CSTE to the CDC's National Notifiable Diseases Surveillance System (NNDSS).[15] Case definition are updated every year using CSTE's position statements:[15,16]

I. Statement of the problem

II. Background and justification

III. Statement of the desired action(s) to be taken

IV. Goals of surveillance

V. Methods for surveillance

VI. Criteria for case ascertainment

VII. Case definition for case classification

VIII. Period of surveillance

The case definition for RMSF has changed three times since 1990 with each update brining new changes to clinical descriptions and laboratory criteria. RMSF was renamed to Spotted Fever Rickettsiosis in 2010.[14]

1990 Case Definition

The clinical definition for RMSF at this time was an illness characterized by a fever and usually accompanied by myalgia, headache, and petechial rash (on the palms and soles in two-thirds of the cases).[17] The laboratory criteria for diagnosis included:[17]

- IFA testing that show a fourfold or greater rise in antibody titer for spotted fever group antigen, complement fixation (CF), latex agglutination (LA), microagglutination (MA), or indirect hemagglutination (IHA) test, or a single titer greater than or equal to 64 by IFA or greater than or equal to 16 by CF
- A positive immunofluorescence of skin lesion (biopsy) or organ tissue (autopsy)
- An isolation of Rickettsia rickettsii from clinical specimen

Confirmed cases are laboratory tested confirmed.[17]

1996 Case Definition

The clinical description for RMSF remained the same during this update with changes mainly affecting laboratory criteria.[18] The biggest addition to the laboratory criteria for diagnosis included a new testing method:[18]

- A positive PCR test result to *Rickettsia rickettsii*

2004 Case Definition

The 2004 case definition expanded on the clinical definition, describing RMSF as a bacterial pathogen transmitted by ticks, mainly the *Dermacentor variabilis* (the American dog tick) and *Dermacentor andersoni* (the Rocky Mountain wood tick).[19] Onset of disease averaged a week timing following a tick bite with age specific illness highest amongst children.[19] Symptoms were also updated and included: acute onset of fever, and may be accompanied by headache, malaise, myalgia, nausea/vomiting, or neurologic signs; a macular or maculopapular rash is

reported in most patients.[19] The laboratory criteria also underwent an update with the following updates:[19]

- Serological evidence of a significant change in serum antibody titer reactive with *Rickettsia rickettsii* antigen between paired serum samples conducted by a commercial, state, or reference laboratory
- Immunohistochemical methods demonstrating the *Rickettsia rickettsii* antigen in a clinical sample

2008 Case Definition

Changes in the 2008 clinical description were few but included *Rhipicephalus sanguineus* (the brown dog tick) as a carrier of RMSF.[20] Older adults were also added as a highest affect age specific illnesses group.[20] The clinical criteria was relatively the same as 2004 but included two new symptoms: thrombocytopenia or any hepatic transaminase elevation. The main change to laboratory testing criteria was an update to IFA testing:[20]

- Serological evidence of a fourfold change in immunoglobulin G (IgG)-specific antibody titer by IFA between paired samples (one taken within the first week and the second 2-4 weeks later)

An exposure section was added and defined exposure as having been in potential tick habitats within the past 2 weeks before onset of symptoms.[20] Case classification also added suspected cases as a category.[20]

2010 Case Definition

The 2010 case definition brought a major change, renaming RMSF to Spotted Fever Rickettsiosis (SFR). A major rationale behind this change was to the inability of commonly available serological tests to differentiate between Rickettsia species.[14] Changes to the clinical

description included other groups of *Rickettsia* species: *Rickettsia parkeri*, Pacific Coast tick fever, and rickettsialpox. Laboratory criteria for confirmed cases remained unchanged with the same four laboratory tests as 2008 listed.[14]

2.2 RMSF Incidence and Surveillance

In 1998, the total cases of RMSF incidence was reported at 1.4 million cases per million person-years.[24] Openshaw et al. analyzed the National Electronic Telecommunications System for Surveillance (NETSS) data from 2000 to 2007 and observed the annual reported incidence of RMSF increased from 1.7 in 2000 to 7 cases per million persons-years (PY) in 2007, with a peak at 7.2 cases per million PY in 2005, the highest rate ever recorded at the time.[21] The average incidence rate from 2000-2003 was 3.0 cases per million PY and increase to 6.8 cases per million PY in 2004-2007. The authors also observed the proportion of cases classified as confirmed RMSF decreased from 15% in 2000 to just 4% in 2007.[21] Also during this time period, the authors noted the majority of cases occurred in the summer months when peak tick activity is expected, only 4% of RMSF cases reported onset of illness in the winter months.[24] Several factors during this time could have influenced the surveillance of RMSF from 2000-2007. In 2001, a new case reporting form (CRF) was introduced for state health departments to use when reporting RMSF cases.[23] The CRF was a supplement system used in connection with NETSS that also reported patient outcome and laboratory testing, bringing greater surveillance.[23] According to the CRFs collected during this time, hospitalized CRF cases decreased from 36.4% in 2000 to 18.1% in 2007 and fatal outcome was only 3.0% in confirmed cases, 0.4% probably cases.[21] In 2004, new test procedures involving enzyme-linked immunosorbent assays became more widely available and used to test 38% of cases in 2005-2007.[21] Openshaw et al. would

conclude and suggest that incidence increase in reported RMSF was related to multiple factors including improved physician awareness, diagnostic practices, and reporting policies.[21]

A study by Drexler et al. summarized the passive surveillance regarding SFR rickettsioses reported to the CDC between 2008 and 2012, analyzing the trends in incidence rates.[5] The authors saw a continual increase in incidence rate from 1.7 cases per million PY in 2000 to 8.5 cases per million PY in 2008 to 14.3 cases per million PY in 2012; the average national incidence of SFR during this time period was 8.9 cases per million PY.[5] Cases of SFR were reported more frequently among males, persons of the white race, and non-Hispanic ethnicities.[5] Children aged <9 had the lowest reported incidence rate (3.8 cases per million PY) while persons aged 60-69 had the highest reported incidence (15 cases per million PY).[5] Although the incidence rate was lowest among children, they continued to experience the highest case fatality rate, 1.6%.[5] The CDC received 10,356 CRF during this time period and reported the case fatality rate at 0.4% and since 2008 hospitalized case slightly increased to 26%.[5] Surveillance data continue to show decreasing fatalities (less than 1%) among SFR cases during this time period.[5,27] As with previous studies, seasonal trends were consistent with the majority of cases being reported during the summer months.[5,21,28,29] This trend varied between regions with the west and northeast showing more cases reported during off-season months and having no distinct seasonalities.[5] Drexler et al. conclude the reporting of increased annual incidence can be attributed to a range of factors such as human interaction with tick habitats, climate or ecological changes, increased awareness and testing, and the evolution of the surveillance process.[5]

2.3 Digital Epidemiology

The field of digital epidemiology, while still relatively new, has been recognized as a possible tool for furthering epidemiological investigations.[33] At its broadest definition, digital epidemiology can be best defined as using digital data to make epidemiological inferences.[32] Among the earliest examples of digital epidemiology was in 2008 when Google's own research team released Google Flu Trends (GFT), which used symptomatic search queries for the purpose of tracking of influenza-like illnesses to project flu trends in the United States.[32,34,35] GFT claimed that by combining search data and CDC's flu tracking information, it could predict flu prevalence two weeks earlier than CDC's data. However, pundits point out the main issue with GFT was the private ownership of data which meant the results could not be replicated or studied independently.[32] GFT eventually failed when at the peak of the 2013 flu season, the estimated prevalence was off by 140%.[35] Researchers at the time determined that the access of digital data must remain unhindered for the usage of public health authorities, researchers, etc. for replication and testing of methods leading to possible advancement in the field.[32]

Google Trends, a statistical analysis tool provided by Google Inc., generates data based on geographical and temporal patterns and search volume based on specific search terms and has been open to the public since 2006.[13,33] A study in Parma, Italy attempted to compare the effectiveness of Google Trends in different two clinical settings: diseases with low and high media coverages. The first group consisting of ''renal colic", ''epistaxis", and ''mushroom poisoning", were chosen based on the reliability and availability of epidemiology data.[33] A second search group consisting of ''meningitis", ''Legionella Pneumophila pneumonia", and ''Ebola fever" was conducted due to major focus by the Italian media at the time.[33] No correlation was found between Google Trends data and epidemiology of the first group and

despite some correlation between data among the second group, Google Trends ultimately failed to reflect any consistent geographical and temporal patterns.[33] The study would conclude that Google Trends did have some modest reliability but ultimately seemed influenced more by media clamor than true epidemiological burden.[33]

Another study conducted by Ratushny et al. decided to examine the correlation between Google Trends and three tickborne diseases (Lyme Disease, Ehrlichiosis, and RMSF) using CDC Morbidity and Mortality Weekly Report (MMWR) data.[30] Ratushny et al. stated from their analysis a correlation between monthly Google search frequency and the MMWR data (Lyme $r=0.69$, $P\leq0.0001$; ehrlichiosis $r=0.59$, $P\leq0.0001$; RMSF $r=0.46$, $P\leq0.0001$).[30] A second analysis was conducted and demonstrated a geographic correlation between states with the most searches for the specific infectious diseases and states with the most reported new infections (for 2012 in order of decreasing correlation: Lyme $r=0.74$, $P\leq0.0001$; RMSF $r=0.64$, $P\leq0.0001$; ehrlichiosis $r=0.32$, $P=0.03$). However, Ratushny et al. do acknowledge severe criticism with their research and methodology, with the biggest criticism stating that the correlations presented in the results do not indicate causality.[30,36] The authors also admit such confounding factors like search terms selection, search algorithms updates by Google, and how media publicity may explain stronger correlation presented in Lyme disease.[30] The authors conclude with the possibility that Google Trends data could be a useful resource in understanding links between climate and infectious diseases.

METHODS

3.1 Data Source

Data was obtained from the National Notifiable Diseases Surveillance System (NNDSS), a nationwide database and collaboration that allows public health officials to share notifiable disease related health information.[37] The CDC Division of Health Informatics and Surveillance (DHIS) supports the NNDSS by providing services that include receiving, securing, processing nationally notifiable disease data to CDC programs.[37] The CSTE collaborates with both programs to determine the conditions for reporting nationally notifiable diseases.[37] Probable and confirmed cases of SFR reported from 2004-2015 was obtained from the NNDSS data. The NNDSS is a secondary data source and a Registration Information and Data Use Restriction Agreement (RUDURA) Form was completed and submitted to CDC Rickettsial Zoonoses Branch for data access.

Data was obtained from the National Oceanic and Atmospheric Administration (NOAA) National Center for Environmental Information (NCEI) database. The NCEI is the largest provider of archivable weather and climate data.[38] Statewide monthly temperature from 2004-2015 for 34 states were obtained from the NCEI. NCEI hosts and provides public access and no prior agreement form is needed for data access.[39]

Data was obtained from the Google Trends database. Google Trends provide both real-time and non-real time data of search terms' interest over time.[13] Interest over time data from 2004-2015 for the search term "Rocky Mountain Spotted Fever" was obtained from Google Trends for 34 states. Google Trends provides public access and no prior agreement form is needed for data access.

3.2 Variables

Onset Cases: An onset case is defined as a probable or confirmed case of SFR according to the 2004, 2008, 2010 CSTE case definition for SFR in the NNDSS dataset. SFR onset cases are reported between 2004-2015.

State: Data for 48 states and Washington DC were made available in the NNDSS data. Alaska and Hawaii were not included in the dataset due to no recorded SFR onset cases ever being reported in either Alaska or Hawaii. Cases where the state origin is unknown are marked with the designation "NZ". Two-letter postal abbreviations were used to label states.

Onset Month: Months were labeled 1-12 corresponding to calendar months in the NNDSS dataset. Cases where month data is missing are labeled with "99".

Onset Year: Years are marked from 2004-2015 in the NNDSS dataset. Cases where year data is missing are labeled with "9999".

Temperature: The NCEI dataset provided average minimum temperature, average temperature, and average max temperature for the chosen analyzed states. Temperature data was collected on the Fahrenheit scale.

Google Trends (Interest Over Time): Interest over time data was indexed on a scale from 0-100 where an index score of 100 is the maximum search interest for a search term in the selected time range and location.[13]

3.3 Sample Selection

The NNDSS dataset provided onset case data for 48 states and Washington DC. To narrow the number of analyzed states, 34 states were chosen based on the CDC's Geographic distribution of SFR incidence in 2014. The 34 states fell under three categories:[8]

1. Annual Incidence Rate ranging from 6.6 to 278 cases per million persons - Alabama, Arkansas, Delaware, Illinois, Kentucky, Mississippi, Missouri, Nebraska, North Carolina, Oklahoma, Tennessee, and Virginia.

2. Annual Incidence Rate ranging from 2.3 to 6.6 cases per million persons - Arizona, Georgia, Indiana, Iowa, Louisiana, Montana, New Jersey, North Dakota, South Carolina, South Dakota, Texas, and West Virginia

3. Annual Incidence Rate ranging from 1.0 to 2.3 cases per million persons - Connecticut, Florida, Maine, Massachusetts, Minnesota, New Hampshire, New York, Oregon, Utah, and Wisconsin

The remaining states had annual incidence rates ranging from 0 to 1.0 cases per million persons and were excluded from the analysis:[8]

4. Annual Incidence Rate ranging from 0.1 to 1.0 cases per million persons - California, Colorado, Idaho, Maryland, Nevada, Ohio, Pennsylvania, and Washington

5. Annual Incidence Rate reportedly 0 per million persons - District of Columbia, Kansas, Michigan, Rhode Island, Vermont, and Wyoming

Cases that did not have a designated state were excluded. From the 34 chosen states, cases where onset month was labeled "99" and/or onset year was labeled "9999" were also excluded.

In one regression analysis, cases, average temperature, and Interest Over Time that were recorded prior to 2008 were excluded to determine if examining onset cases under a more recent SFR case definition improved predictability with average temperature and Interest Over Time. The year 2008 was chosen due to the inclusion of immunoglobulin G (IgG)-specific IFA testing, the most common IFA test used at the CDC, in the CSTE RMSF case definition.[20]

3.4 Statistical Procedure

Statistical Analysis Software (SAS) version 9.4 was used to analyze the data. A simple linear regression analysis was first conducted on onset cases to compare the predictability and measure the significance between average minimum temperature, average temperature, and average maximum temperature, Interest Over Time. A multiple regression analysis was performed to determine if adding one or more of the variables (average min temperature, average temperature, average max temperature, Interest Over Time) improved the predictability between variables. A model's significance will be measured by the F-value and t-test. The coefficient variable and R^2 will be used to compare different model's predictability. Any p-value of $p < 0.05$ establishes statistical significance.

RESULTS

4.1 Description of the Dataset Sample

From 2004-2015, 27,333 onset cases were reported to the NNDSS. The total amount of onset cases per state is shown in Figure 1. North Carolina had the highest amount of reported (5,777 onset cases) and Connecticut had the lowest (2 onset cases). The months of June and July had the most reported with 5,654 onset cases and 5,196 onset cases reported respectively (Figure 2). Figure 4 shows a breakdown of United States region: South (21376 onset cases), Midwest (4459 onset cases), Northeast (1043 onset cases), and West (455 onset cases). The year 2012 and 2015 had the highest peak of reported SFR onset cases and Google Trends search interest for the term "Rocky Mountain Spotted Fever" was highest in 2004.

4.2 Simple Regression Analysis of Google Trends with Total Onset Cases

Figure 6 shows the simple regression analysis between Google Trends (Interest Over Time) as the predictor to onset cases. The results of the regression analysis indicated the model to be statistically significant, the predictor Interest Over Time explained 52.62% of the variance ($R^2 = 0.5262$, $F_{1,143}=157.69$, $p < 0.0001$). The predictor Interest Over Time was also found to be statistically significant ($\beta = 6.57$, $t_1 = 12.56$, $p < 0.0001$).

4.3 Regression Analysis of Temperature

The original sample size of 48 states and Washington DC (n=7,352) was reduced to 34 states (n=4,860) based on states with a reported incidence of 1.0+ case per million person-years in 2014. For this analysis, 3 models would be tested:

Model 1. Onset case = Avg Min Temp

Model 2. Onset case = Avg Temp

Model 3. Onset case = Avg Max Temp

Simple regression analysis was used to test if temperature significantly predicted onset cases. The results from the regression analysis is shown in Figure 7. The results of the simple regression analysis indicated models 1, 2, 3 to be a statistically significant model in 31 out of 34 states. All three models were not a statistically significant model for Oregon, New Hampshire, and Connecticut.

A multiple regression analysis was conducted to determine if adding different temperature variables into the model improved a model's predictability:

Model 1: onset case = Avg Min Temp + Avg Temp

Model 2: onset case = Avg Temp + Avg Max Temp

Model 3: onset case = Avg Min Temp + Avg Max Temp

Model 4: onset case = Avg Min Temp + Avg Temp + Avg Max Temp

However, the results of the multiple regression analysis indicated model 1 and model 3 to be a statistically significant model in 1 state (Missouri) where both predictors are statistically significant. Model 2 was a statistically significant model for 2 states (Missouri and Alabama) where both predictors are statistically significant. Model 4 was a statistically significant model in 0 states where all three predictors are statistically significant.

For all statistically significant models, the predicted variance in R^2 is negligible between models for each state.

4.3 Regression Analysis of Temperature and Google Trends for Each State

Simple regression analysis was used to test if Interest Over Time significantly predicted onset cases (Figure 8). The results of this regression indicated the predictor Interest Over Time to be statistically significant in only 14 of 34 states. Multiple regression analysis was used to test if average temperature and Interest Over Time significantly predicted onset case. The results of this

regression indicated the model for these two predictors to be a statistically significant model in only 5 of 34 states where both predictors are statistically significant. For all statistically significant models, R^2 was highest in the model (onset case = average temperature + Interest Over Time).

Multiple regression analysis was used to test each temperature variable with Interest Over Time to determine which model was statistically significant in more states (Figure 9):

Model 1: onset case = Avg Min Temp + Interest Over Time

Model 2: onset case = Avg Temp + Interest Over Time

Model 3: onset case = Avg Max Temp + Interest Over Time

Model 4: onset case = Avg Min Temp + Avg Temp + Avg Max Temp + Interest Over Time

The results from this regression indicated model 1 and model 2 to be a statistically significant model in 5 of 34 states where both predictors are statistically significant. Model 3 is a statistically significant model in 4 of 34 states where both predictors are statistically significant. Model 4 is statistically significant model in 0 states where all three predictors are statistically significant.

4.4 Regression Analysis of Average Temperature and Google Trends for Each State Beyond 2008

Simple and multiple regression analysis was conducted to determine if there was any change for average temperature and Interest Over Time's statistical significance with onset cases (Figure 10).

Simple regression analysis was used to test if average temperature significantly predicted onset cases. The results of this regression indicated the predictor average temperature's model to

be a statistically significant model in 30 of 34 states. Simple regression analysis was used to test if Interest Over Time significantly predicted onset cases. The results of this regression indicated the predictor Interest Over Time's model to be a statistically significant model in only 19 of 34 states.

Multiple regression analysis was used to test if average temperature and Interest Over Time significantly predicted onset case. The results of this regression indicated the model for these two predictors to be statistically significant model in only 8 of 34 states where both predictors are statistically significant. For all statistically significant models, R^2 was highest in the model: onset case = average temperature + Interest Over Time.

A table comparing the ratios of statistically significant models between data analyzed from 2004-2015 and 2008-2015 can be found in Figure 11.

DISCUSSION AND CONCLUSION

5.1 Discussion

Temperature

It is important to remember the definition of an onset case is a probable or confirmed case of Spotted Fever Rickettsiosis. Also, the CSTE case definition for Rocky Mountain Spotted Fever was changed in 2010 to Spotted Fever Rickettsiosis due to the inability of current serological testing to differentiate between certain *Rickettsia* diseases.[5,13]

The number of reported onset cases has generally increased per year with dips present in 2009 and 2013 (Figure 1). The monthly distribution of SFR onset cases also reflect previous studies' findings that the majority of reported onset cases occurred in the summer months, particularly June and July (Figure 3 and Figure 4).[5, 8, 30,31] Specific regions within the United States also reflect the trend of cases occurring in the summer months however some regions, such as the northeast and west, have less defined seasonality distinction (Figure 4). Drexler et al. also stated this observation and provided a possible explanation that length of tick-feeding activity for regions in the west could be the result of moderate year-round temperatures while rickettsialpox cases could explain off-season SFR cases in the northeast.[5] The reporting peaks for SFR has been consistent every year from 2004-2015, with the peaks occurring in the summer months (Figure 5). The data provided by this study supports this trend; climate and temperature show an association with onset cases. There was no difference in the statistical significance between average minimum temperature, average temperature, average maximum temperature with each variable individually being statistically significant to onset cases in 31 out of 34 states. The three states where temperature was not a statistically significant predictor could be a result of the low onset case total. However, it would be incorrect to assume warmer temperature is

correlated with higher reported onset case. Rather it is important to understand that climate and temperature are related to the risk of exposure to SFR. The warmer the weather, the higher the possibility for people to participate in outdoor activities around tick habitats and be exposed to ticks. Tick exposure is greatest in the summer seasons due to acceleration of a tick's developmental cycle and extension of a ticks' developmental cycle from warmer temperature.[40] The strong statistical significance between temperature and onset case represents the association of exposure risk to SFR in higher temperature.

Google Trends

While figure 5 does show the onset case and Google trend curve peaks overlapping around the same time and figure 6 presents Google Trends as a statistically significant predictor for onset case, it must be noted that a rise in Google search interest for "Rocky Mountain Spotted Fever" does not necessary correlate to increased onset cases. Currently the reason why people search for "Rocky Mountain Spotted Fever" is unclear. Are people searching before the onset of illness or after? Did a family member get bit by a tick? Is media exposure generating interest in the topic? These are some questions that are currently unanswerable with the current version of Google Trends. With these factors in mind, there appears to be a strong association between Google Trends and reported onset cases when analyzing the United States as a country (Figure 6). However, this association is not as strong when comparing at an individual state level.

It is interesting to note when analyzing data after 2008, Google Trends is a statistically significant variable for onset cases in 19 states; with the top 12 states of reported onset SFR among them. A model using both average temperature and Google Trends was statistically significant for 30 states and had a higher R^2 in all 30 states, however only in 8 of the models were both predictors statistically significant in the model. Google trends had the greatest R^2 in

North Carolina, a state with almost 2,000 more reported onset cases than the next highest state, Arkansas. This study shows that although using both temperature and google trends as predictors does improve the predictability (R^2) when compared to models of only 1 predictor, there are fewer statistically significant models where both predictors are statistically significant.

5.2 Limitations

As a cross-sectional study using secondary data from NNDSS 2004-2015, by definition this study only provides a glimpse of a population and cannot demonstrate casual inferences but rather association between variables. Limitations with using the NNDSS data is that each state collect and reports their SFR data differently and the CSTE case definition for RMSF/SFR changed 3 times in my dataset's time period, potentially resulting in unrepresentative samples. Onset cases also not only represent cases of SFR but also probable cases. There is a possibility of cases not developing SFR, resulting in a misrepresentation of the general population affected by SFR. Another example of misrepresentation is that this study only analyzed search volume for "Rocky Mountain Spotted Fever". People could be use different but related search terms such as "RMSF", "*Rickettsia rickettsia*", "rash", "tick", etc.

Limitations with the usage of Google Trends involve the unknown factors that drives a population to search a specific term. Certain forces that drive google searches could be connected to media coverage, social media, or other factors.[41] An example is in 2013, search peak for "Rocky Mountain Spotted Fever" reached a search index of 80 around the summer months, the highest value since 2008. A possible explanation to this increase in search volume could have been the release of *World War Z* on June 21, 2013, a movie starring Brad Pitt, a famous and popular actor, who name dropped "Rocky Mountain Spotted Fever" in the movie.[42]

5.3 Implications of Findings

This analysis provides an introductory look into the usage of Google Trends in predicting epidemiological curves. Although the statistical significance of Google Trends as a predicter for onset cases was modest at best, further work is needed to properly examine the statistical impact of digital data with epidemiology. Future research involving analyses of different search terms or associated variables regarding certain diseases could improve Google Trends and other digital data as statistical significant variables when compared to epidemiological curves. With Google Trends and temperature having a strong association with predicted variability of onset cases in North Carolina, a state with almost 2,000 more reported cases than the second highest state, this begs the question if certain total case threshold needs to be met for Google Trends to become a valuable tool. Future research could involve analyzing the association of other variables with onset cases and their inclusion in predictability models. One such variable is precipitation and as previously stated, is a major factor on tick activity and feeding period. From a geographical standpoint, breaking down where onset cases are happening within states and comparing this data with search interest location could also reveal other associations.

5.4 Conclusions

The use of Google Trends as an epidemiological tool has gained some ground within the past few years. As technology advances, the viability of using digital data grows as it can provide a real-time window into the minds of people and their interests. Other studies have already shows the unreliability of using Google Trends as it can be influenced by the media or factors beyond a public health setting. Greater transparency behind the methodology of Google Trends is needed for it to become a valuable asset as there are too many unknowns that make it difficult for public

health researchers to assess the true association Google Trends or other digital data has with the epidemiology of a disease.

FIGURES

Figure 1: Total amount of reported onset cases in the United States by year (2004-2015)

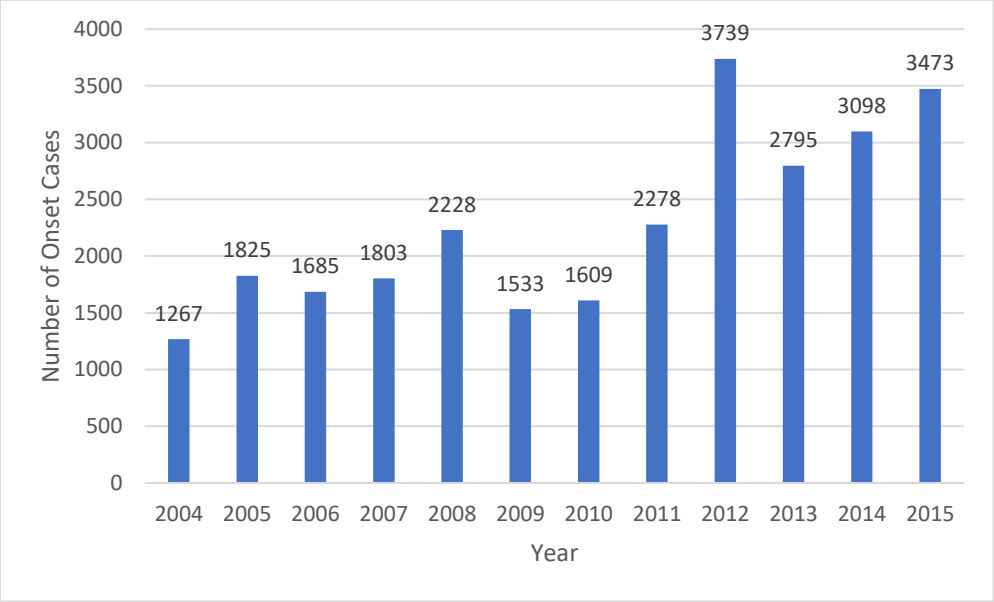

Figure 2: Total Amount of Onset Cases by State (2004-2015)

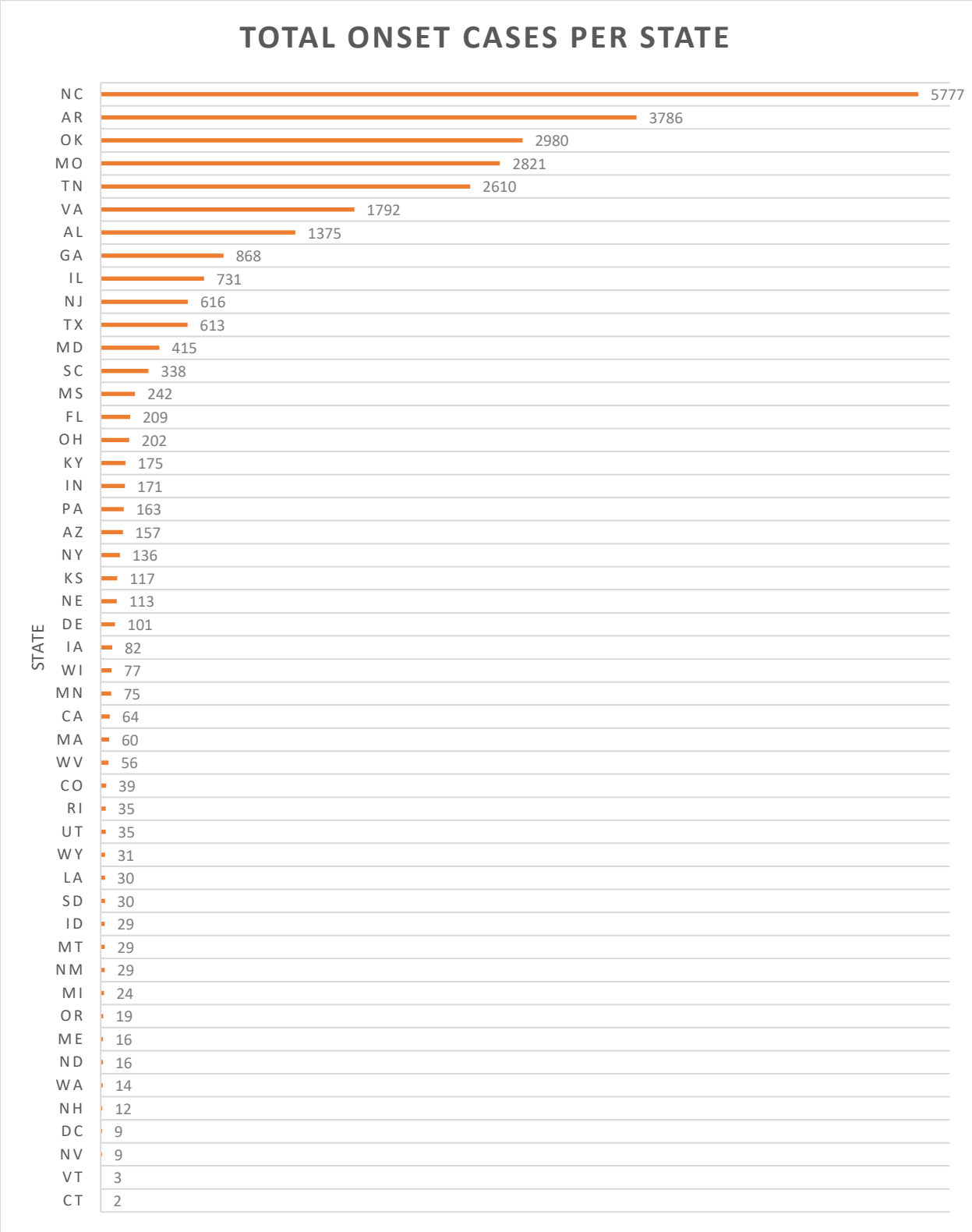

Figure 3: Month of onset SFR cases in the United States, 2004-2015

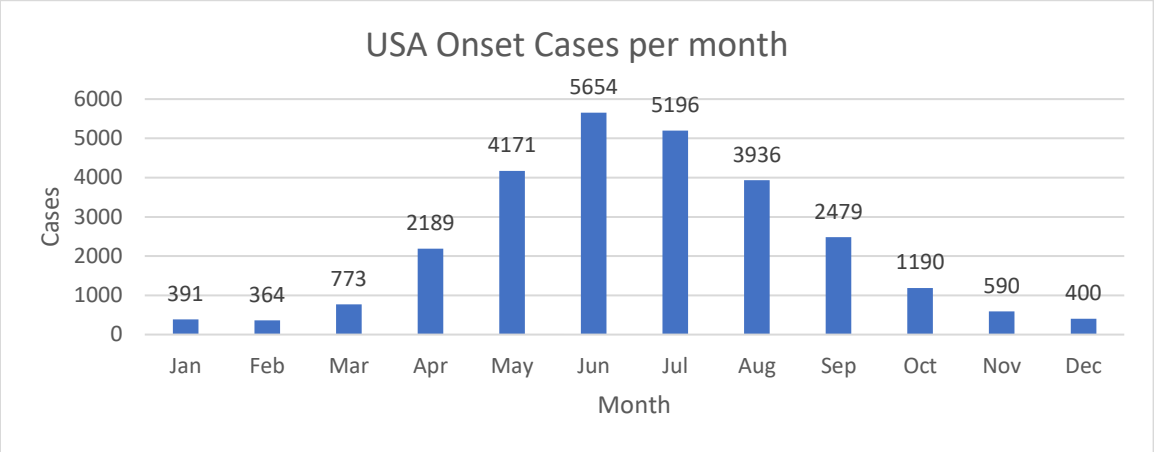

Figure 4: Month of onset SFR cases by regions of the United State

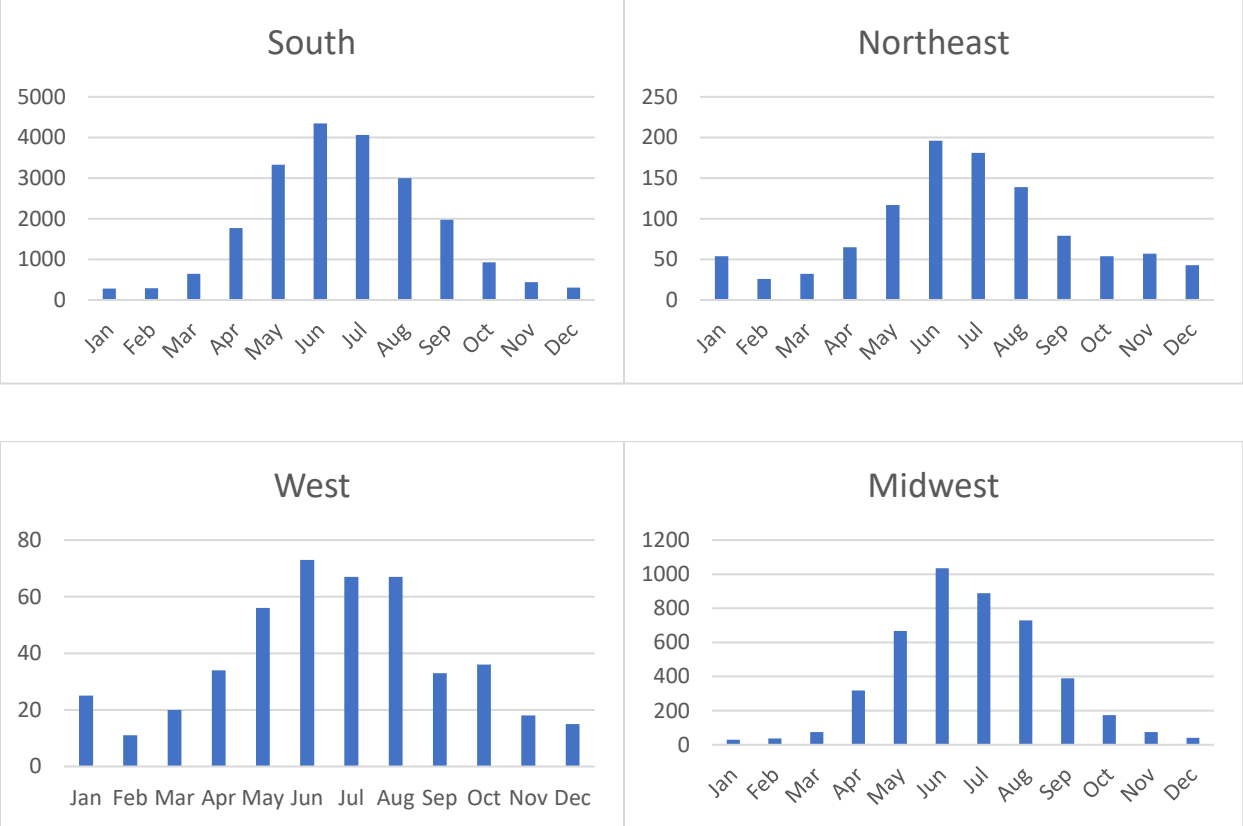

Figure 5: United States reported onset case and Google Trends interest over time, 2004-2015

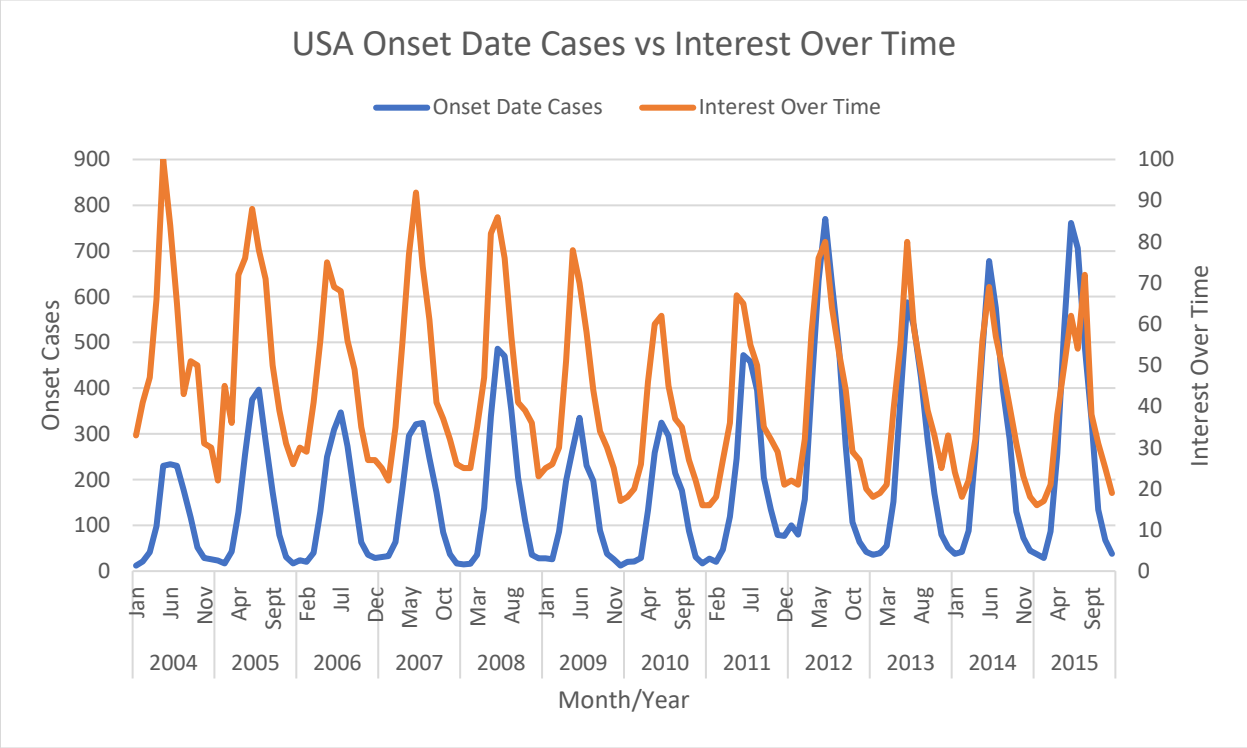

Figure 6: SAS output, regression analysis with Google Trends as predictor for onset cases

The REG Procedure
Model: MODEL1
Dependent Variable: Onset_Cases Onset Cases

Number of Observations Read	144
Number of Observations Used	144

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	2516062	2516062	157.69	<.0001
Error	142	2265680	15955		
Corrected Total	143	4781742			

Root MSE	126.31507	R-Square	0.5262
Dependent Mean	189.81250	Adj R-Sq	0.5228
Coeff Var	66.54729		

Parameter Estimates						
Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	-93.70893	24.91097	-3.76	0.0002
Interest_Over_Time	Interest Over Time	1	6.56701	0.52295	12.56	<.0001

Figure 7: Summary of SAS output for predictor temperature with onset cases

State (Onset Cases)	Variables Tested	F-Value, p-value	Coefficient Var	R-Square	T-Test, p-value		
					Min Temp	Avg Temp	Max Temp
NC (5777)	Min Temp	232.09, <.0001	62.39	0.6204	15.23, <.0001		
	Avg Temp	234.80, <.0001	62.17	0.6231		15.32, <.0001	
	Max Temp	229.46, <.0001	62.61	0.6177			15.15, <.0001
	Min/Avg	116.63, <.0001	62.38	0.6232	0.20, 0.8434	1.03, 0.3051	
	Avg/Max	116.60, <.0001	62.38	0.6232		-0.15, 0.8838	1.43, 0.1547
	Min/Max	116.70, <.0001	62.36	0.6234	1.47, 0.1477		1.06, 0.2932
	Min/Avg/Max	77.67, <.0001	62.48	0.6247	0.74, 0.4581	-0.69, 0.4883	0.73, 0.4654
AR (3786)	Min Temp	55.48, <.0001	124.01	0.2809	7.45, <.0001		
	Avg Temp	53.67, <.0001	124.58	0.2743		7.33, <.0001	
	Max Temp	51.13, <.0001	125.39	0.2648			7.15, <.0001
	Min/Avg	27.94, <.0001	124.19	0.2838	1.37, 0.1728	-0.76, 0.4505	
	Avg/Max	27.85, <.0001	124.25	0.2832		1.90, 0.0591	-1.32, 0.1891
	Min/Max	27.92, <.0001	124.21	0.2837	1.93, 0.0557		-0.73, 0.4649
	Min/Avg/Max	18.78, <.0001	124.36	0.287	0.87, 0.3866	-0.81, 0.4194	0.79, 0.4321
OK (2980)	Min Temp	221.49, <.0001	58.99	0.6093	14.88, <.0001		
	Avg Temp	214.15, <.0001	59.60	0.6013		14.63, <.0001	
	Max Temp	200.37, <.0001	60.78	0.5852			14.61, <.0001
	Min/Avg	110.33, <.0001	59.14	0.6101	1.79, 0.0760	-0.53, 0.5976	
	Avg/Max	110.08, <.0001	59.18	0.6096		2.97, 0.0035	-1.73, 0.0853
	Min/Max	110.29, <.0001	59.15	0.61	2.99, 0.0032		-0.50, 0.6156
	Min/Avg/Max	73.82, <.0001	59.15	0.6127	1.06, 0.2920	-0.98, 0.3297	0.96, 0.3364
MO (2821)	Min Temp	200.68, <.0001	74.40	0.5856	14.17, <.0001		
	Avg Temp	188.19, <.0001	75.79	0.5699		13.72, <.0001	
	Max Temp	173.82, <.0001	77.50	0.5504			13.18, <.0001
	Min/Avg	105.72, <.0001	73.36	0.5999	3.25, 0.0014	-2.25, 0.0263	
	Avg/Max	105.34, <.0001	73.44	0.5991		4.14, <.0001	-3.20, 0.0017
	Min/Max	105.60, <.0001	73.38	0.5997	4.17, <.0001		-2.22, 0.0277
	Min/Avg/Max	70.27, <.0001	73.53	0.6009	0.80, 0.4235	-0.66, 0.5105	0.59, 0.5582
TN (2610)	Min Temp	89.85, <.0001	101.02	0.3875	9.48, <.0001		
	Avg Temp	86.31, <.0001	101.78	0.3782		9.29, <.0001	
	Max Temp	81.22, <.0001	102.95	0.3639			9.01, <.0001
	Min/Avg	45.21, <.0001	101.11	0.3907	1.70, 0.0909	-0.86, 0.3913	
	Avg/Max	45.22, <.0001	101.11	0.3908		2.49, 0.0138	-1.71, 0.0904
	Min/Max	45.21, <.0001	101.11	0.3907	2.49, 0.0138		-0.86, 0.3900
	Min/Avg/Max	29.93, <.0001	101.47	0.3908	0.01, 0.9927	0.07, 0.9469	-0.09, 0.9271
VA (1792)	Min Temp	84.76, <.0001	105.03	0.3738	9.21, <.0001		
	Avg Temp	83.91, <.0001	105.23	0.3714		9.16, <.0001	
	Max Temp	81.18, <.0001	105.87	0.3637			9.01, <.0001
	Min/Avg	42.08, <.0001	105.41	0.3738	0.73, 0.4677	0.03, 0.9782	
	Avg/Max	42.20, <.0001	105.35	0.3745		1.55, 0.1224	-0.83, 0.4100
	Min/Max	42.08, <.0001	105.41	0.3738	1.50, 0.1349		-0.02, 0.9827
	Min/Avg/Max	29.20, <.0001	104.84	0.3849	-1.54, 0.1252	1.59, 0.1137	-1.59, 0.1137
AL (1375)	Min Temp	119.52, <.0001	86.01	0.457	10.93, <.0001		
	Avg Temp	111.27, <.0001	87.39	0.4393		10.55, <.0001	
	Max Temp	99.41, <.0001	89.52	0.4118			9.97, <.0001
	Min/Avg	61.54, <.0001	85.59	0.4661	2.66, 0.0088	-1.55, 0.1241	
	Avg/Max	61.66, <.0001	85.55	0.4665		3.80, 0.0002	-2.68, 0.0082
	Min/Max	61.58, <.0001	85.57	0.4662	3.79, 0.0002		-1.56, 0.1209
	Min/Avg/Max	40.89, <.0001	85.82	0.467	-0.35, 0.7304	0.45, 0.6554	-0.49, 0.6246
GA (868)	Min Temp	156.60, <.0001	71.79	0.5244	12.51, <.0001		
	Avg Temp	156.09, <.0001	71.85	0.5236		12.49, <.0001	
	Max Temp	148.32, <.0001	72.81	0.5109			12.18, <.0001
	Min/Avg	78.05, <.0001	71.97	0.5254	0.72, 0.4707	0.53, 0.5961	
	Avg/Max	78.11, <.0001	71.96	0.5256		2.09, 0.0382	-0.77, 0.4442
	Min/Max	78.02, <.0001	71.98	0.5253	2.07, 0.0403		0.51, 0.6124
	Min/Avg/Max	52.15, <.0001	72.05	0.5277	-0.79, 0.4309	0.84, 0.3997	-0.83, 0.4078
IL (730)	Min Temp	68.03, <.0001	117.70	0.3239	8.25, <.0001		
	Avg Temp	67.83, <.0001	177.76	0.3233		8.24, <.0001	
	Max Temp	66.87, <.0001	118.02	0.3202			8.18, <.0001
	Min/Avg	33.80, <.0001	118.10	0.3241	0.41, 0.6841	0.17, 0.8613	
	Avg/Max	33.78, <.0001	118.11	0.3239		0.89, 0.3772	-0.37, 0.7108
	Min/Max	33.80, <.0001	118.10	0.3241	0.91, 0.3670		0.19, 0.8484
	Min/Avg/Max	22.52 <.0001	118.39	0.3255	0.58 0.5648	-0.55 0.5854	0.55 0.5817
NJ (616)	Min Temp	53.16, <.0001	90.90	0.2724	7.29, <.0001		
	Avg Temp	53.56, <.0001	90.81	0.2739		7.32, <.0001	
	Max Temp	53.27, <.0001	90.87	0.2728			7.30, <.0001
	Min/Avg	26.59, <.0001	91.13	0.2739	-0.02, 0.9814	0.54, 0.5887	
	Avg/Max	26.59, <.0001	91.13	0.2739		0.46, 0.6475	0.02, 0.9839
	Min/Max	26.59, <.0001	91.13	0.2739	0.46, 0.6488		0.54, 0.5899
	Min/Avg/Max	17.60, <.0001	91.45	0.2739	-0.05, 0.9633	0.06, 0.9505	-0.04, 0.9645
TX (613)	Min Temp	15.60, 0.0001	76.50	0.099	3.95, 0.0001		
	Avg Temp	16.11, <.0001	76.38	0.1019		4.01, <.0001	
	Max Temp	16.26, <.0001	76.34	0.1028			4.03, <.0001
	Min/Avg	8.07, 0.0005	76.61	0.1027	-0.36, 0.7182	0.77, 0.4451	
	Avg/Max	8.07, 0.0005	76.61	0.1028		0.05, 0.9616	0.37, 0.7093
	Min/Max	8.08, 0.0005	76.61	0.1028	0.05, 0.9572		0.77, 0.4415
	Min/Avg/Max	5.36, 0.0016	76.87	0.103	0.20, 0.8423	-0.20, 0.8434	0.22, 0.8261

SC (338)	Min Temp	96.05, <.0001	84.42	0.4035	9.80, <.0001		
	Avg Temp	95.30, <.0001	84.55	0.4016		9.76, <.0001	
	Max Temp	91.80, <.0001	85.18	0.3926			9.58, <.0001
	Min/Avg	47.71, <.0001	84.71	0.4036	0.69, 0.4916	0.17, 0.8630	
	Avg/Max	47.72 <.0001	84.71	0.4036		1.61 0.1090	-0.69 0.4894
	Min/Max	47.71, <.0001	84.71	0.4036	1.61, 0.1094		0.17, 0.8650
	Min/Avg/Max	31.59 <.0001	85.01	0.4037	-0.04 0.9689	0.08 0.9326	-0.08 0.9367
MS (242)	Min Temp	23.46, <.0001	196.88	0.1418	4.84, <.0001		
	Avg Temp	22.21, <.0001	197.62	0.1353		4.71, <.0001	
	Max Temp	20.44, <.0001	198.70	0.1258			4.52, <.0001
	Min/Avg	12.19, <.0001	196.93	0.1474	1.41, 0.1593	-0.96, 0.3390	
	Avg/Max	12.34 <.0001	196.74	0.149		1.96 0.0520	-1.51, 0.1338
	Min/Max	12.24 <.0001	196.87	0.1479	1.91 0.0577		-1.01 0.3156
	Min/Avg/Max	9.18 <.0001	195.66	0.1643	-1.60 0.1111	1.66 0.0996	-1.69 0.0940
FL (209)	Min Temp	12.46, 0.0006	96.29	0.0807	3.53, 0.0006		
	Avg Temp	12.34, 0.0006	96.32	0.0799		3.51, 0.0006	
	Max Temp	11.82, 0.0008	96.49	0.0769			3.44, 0.0008
	Min/Avg	6.19, 0.0027	96.63	0.0807	0.34, 0.7375	0.01, 0.9927	
	Avg/Max	6.20, 0.0026	96.62	0.0808		0.78, 0.4353	-0.37, 0.7117
	Min/Max	6.19, 0.0027	96.63	0.0807	0.77, 0.4446		-0.01, 0.9918
	Min/Avg/Max	4.18, 0.0072	96.89	0.0822	-0.46, 0.6489	0.48, 0.6305	-0.48, 0.6305
AZ (180)	Min Temp	10.58, 0.0015	108.04	0.0907	3.25, 0.0015		
	Avg Temp	11.18, 0.0011	107.76	0.0954		3.34, 0.0011	
	Max Temp	11.51, 0.0010	107.61	0.098			3.39, 0.0010
	Min/Avg	5.74, 0.0043	108.09	0.0986	-0.60, 0.5466	0.95, 0.3419	
	Avg/Max	5.75, 0.0043	108.08	0.0987		-0.29, 0.7714	0.62, 0.5390
	Min/Max	5.75, 0.0043	108.08	0.0987	-0.29, 0.7758		0.96, 0.3391
	Min/Avg/Max	3.81, 0.0122	108.57	0.0991	0.23, 0.8210	-0.23, 0.8154	0.26, 0.7988
KY (175)	Min Temp	19.54, <.0001	238.61	0.1209	4.42, <.0001		
	Avg Temp	18.21, <.0001	239.59	0.1137		4.27, <.0001	
	Max Temp	16.89, <.0001	240.59	0.1063			4.11, <.0001
	Min/Avg	10.79, <.0001	237.84	0.1327	1.76, 0.0805	-1.38, 0.1683	
	Avg/Max	10.56, <.0001	238.19	0.1302		1.97, 0.0508	-1.64, 0.1038
	Min/Max	10.70, <.0001	237.97	0.1318	2.04, 0.0437		-1.33, 0.1866
	Min/Avg/Max	8.94 <.0001	234.80	0.1608	2.26 0.0255	-2.20 0.0295	2.16 0.0323
IN (171)	Min Temp	59.11, <.0001	142.01	0.2939	7.69, <.0001		
	Avg Temp	56.92, <.0001	142.79	0.2862		7.54, <.0001	
	Max Temp	54.34, <.0001	143.73	0.2768			7.37, <.0001
	Min/Avg	30.12, <.0001	141.96	0.2994	1.63, 0.1053	-1.05, 0.2969	
	Avg/Max	30.12, <.0001	141.97	0.2993		2.13, 0.0348	-1.63 0.1057
	Min/Max	30.12, <.0001	141.96	0.2994	2.13, 0.0347		-1.05, 0.2969
	Min/Avg/Max	19.94, <.0001	142.47	0.2994	0.08, 0.9360	-0.01, 0.9890	-0.01, 0.9882
NY (136)	Min Temp	29.78, <.0001	141.22	0.1734	5.46, <.0001		
	Avg Temp	31.51, <.0001	140.51	0.1816		5.61, <.0001	
	Max Temp	32.71, <.0001	140.03	0.1872			5.72, <.0001
	Min/Avg	16.98, <.0001	139.93	0.1941	-1.48, 0.1416	1.90, 0.0589	
	Avg/Max	16.91, <.0001	139.98	0.1935		-1.04, 0.2979	1.44, 0.1522
	Min/Max	16.94, <.0001	139.96	0.1937	-1.07, 0.2884		1.89, 0.0614
	Min/Avg/Max	11.41, <.0001	140.22	0.1964	-0.72, 0.4725	0.69, 0.4915	-0.64, 0.5235
NE (113)	Min Temp	61.36, <.0001	133.25	0.3017	7.83, <.0001		
	Avg Temp	59.76, <.0001	222.33	0.2962		7.73, <.0001	
	Max Temp	57.41, <.0001	134.56	0.2879			7.58, <.0001
	Min/Avg	30.79, <.0001	133.50	0.304	1.26, 0.2098	-0.68, 0.4963	
	Avg/Max	30.92, <.0001	133.42	0.3048		1.85, 0.0658	-1.33, 0.1871
	Min/Max	30.83, <.0001	133.48	0.3042	1.82, 0.0709		-0.71, 0.4763
	Min/Avg/Max	21.12, <.0001	133.25	0.3115	-1.17, 0.2456	1.22, 0.2253	-1.24, 0.2185
DE (101)	Min Temp	18.14, <.0001	182.42	0.1133	4.26, <.0001		
	Avg Temp	18.07, <.0001	182.46	0.1129		4.25, <.0001	
	Max Temp	17.86, <.0001	182.58	0.1117			4.23, <.0001
	Min/Avg	9.01, 0.0002	183.06	0.1133	0.25, 0.7999	0.03, 0.9791	
	Avg/Max	9.00, 0.0002	183.08	0.1132		0.48, 0.6287	-0.22, 0.8275
	Min/Max	9.01, 0.0002	183.06	0.1133	0.50, 0.6159		0.04, 0.9655
	Min/Avg/Max	6.04, 0.0007	183.58	0.1146	0.48, 0.6317	-0.46, 0.6453	0.46, 0.6444
IA (82)	Min Temp	61.68, <.0001	129.82	0.3028	7.85, <.0001		
	Avg Temp	59.9, <.0001	130.39	0.2967		7.74, <.0001	
	Max Temp	57.57, <.0001	131.15	0.2885			7.59, <.0001
	Min/Avg	31.23, <.0001	129.89	0.307	1.45, 0.1502	-0.92, 0.3609	
	Avg/Max	31.37, <.0001	129.80	0.3079		1.99, 0.0485	-1.51, 0.1325
	Min/Max	31.27, <.0001	129.86	0.3073	1.96, 0.0524		-0.95, 0.3444
	Min/Avg/Max	21.32, <.0001	129.73	0.3136	-1.08, 0.2835	1.14, 0.2576	-1.16, 0.2469
WI (76)	Min Temp	23.84, <.0001	167.68	0.1438	4.88, <.0001		
	Avg Temp	23.92, <.0001	167.64	0.1442		4.89, <.0001	
	Max Temp	23.83, <.0001	167.69	0.1437			4.88, <.0001
	Min/Avg	11.88, <.0001	168.23	0.1442	0.07, 0.9443	0.27, 0.7887	
	Avg/Max	11.88, <.0001	168.24	0.1442		0.28, 0.7789	0.02, 0.9825
	Min/Max	11.89, <.0001	168.22	0.1443	0.33, 0.7420		0.31, 0.7556
	Min/Avg/Max	9.00, <.0001	167.10	0.1617	1.71, 0.0895	-1.70, 0.0911	1.71, 0.0897

MN (75)	Min Temp	28.92 <.0001	163.50	0.1692	5.38 <.0001		
	Avg Temp	29.56, <.0001	163.19	0.1723		5.44, <.0001	
	Max Temp	29.90, <.0001	163.03	0.1739			5.47, <.0001
	Min/Avg	14.91, <.0001	163.54	0.1746	-0.63, 0.5299	0.96, 0.3383	
	Avg/Max	14.90, <.0001	163.55	0.1745		-0.30, 0.7616	0.61, 0.5423
	Min/Max	14.90, <.0001	163.55	0.1745	-0.31, 0.7538		0.95, 0.3429
	Min/Avg/Max	9.91, <.0001	164.07	0.1752	-0.35, 0.7301	0.34, 0.7370	-0.31, 0.7568
MA (61)	Min Temp	15.57, 0.0001	173.55	0.0988	3.95, 0.0001		
	Avg Temp	15.08, 0.0002	173.81	0.096		3.88, 0.0002	
	Max Temp	14.47, 0.0002	174.15	0.0925			3.80, 0.0002
	Min/Avg	7.96, 0.0005	173.91	0.1014	0.92, 0.3591	-0.64, 0.5233	
	Avg/Max	8.00, 0.0005	173.87	0.1019		1.21, 0.2270	-0.96, 0.3400
	Min/Max	7.97, 0.0005	173.89	0.1016	1.19, 0.2343		-0.66, 0.5113
	Min/Avg/Max	5.39, 0.0015	174.32	0.1035	-0.51, 0.6116	0.55 0.5821	-0.57, 0.5676
WV (56)	Min Temp	27.02, <.0001	148.31	0.1598	5.20, <.0001		
	Avg Temp	25.99, <.0001	148.76	0.1547		5.10, <.0001	
	Max Temp	24.58, <.0001	149.39	0.1475			4.96 <.0001
	Min/Avg	13.64, <.0001	148.63	0.1621	1.12, 0.2665	-0.62, 0.5357	
	Avg/Max	13.71, <.0001	148.57	0.1628		1.60 0.1107	-1.17, 0.2451
	Min/Max	13.66, <.0001	148.61	0.1623	1.58, 0.1169		-0.65, 0.5195
	Min/Avg/Max	9.47, <.0001	148.58	0.1686	-0.99, 0.3247	1.03, 0.3044	-1.05, 0.2974
UT (35)	Min Temp	7.58 0.0067	224.39	0.0507	2.75 0.0067		
	Avg Temp	7.80, 0.0059	224.22	0.0521		2.79, 0.0059	
	Max Temp	7.96, 0.0055	224.11	0.0531			2.82 0.0055
	Min/Avg	4.02, 0.0201	224.80	0.0539	-0.52 0.6067	0.69 0.4905	
	Avg/Max	4.05, 0.0195	224.75	0.0543		-0.43, 0.6666	0.58, 0.5657
	Min/Max	4.04, 0.0198	224.77	0.0541	-0.40, 0.6903		0.72, 0.4736
	Min/Avg/Max	2.85, 0.0398	225.17	0.0575	0.69, 0.4913	-0.71, 0.4794	0.74, 0.4632
MT (31)	Min Temp	5.10, 0.0255	297.47	0.0347	2.26, 0.0255		
	Avg Temp	4.62, 0.0334	297.96	0.0315		2.15, 0.0334	
	Max Temp	6.73, 0.0104	295.83	0.0453			2.60, 0.0104
	Min/Avg	3.64, 0.0286	296.28	0.0492	1.62, 0.1076	-1.47, 0.1448	
	Avg/Max	4.92, 0.0086	293.77	0.0652		-1.73, 0.0853	2.26, 0.0257
	Min/Max	4.13, 0.0180	295.30	0.0554	-1.23, 0.2213		1.76, 0.0807
	Min/Avg/Max	3.85 0.0110	293.07	0.0762	1.29, 0.1980	-1.78, 0.0777	2.03, 0.0447
LA (30)	Min Temp	4.62, 0.0332	249.92	0.0315	2.15, 0.0332		
	Avg Temp	4.72, 0.315	249.84	0.0322		2.17, 0.0315	
	Max Temp	4.72, 0.0316	249.85	0.0321			2.17, 0.0316
	Min/Avg	2.35, 0.0989	250.71	0.0323	-0.13, 0.8961	0.33, 0.7416	
	Avg/Max	2.35, 0.0993	250.72	0.0322		0.11, 0.9100	0.09, 0.9254
	Min/Max	2.35, 0.0995	250.72	0.0322	0.09, 0.9246		0.31, 0.7560
	Min/Avg/Max	1.67, 0.1763	251.31	0.0345	-0.58, 0.5625	0.58, 0.5603	-0.57, 0.5674
SD (29)	Min Temp	20.56, <.0001	237.41	0.1265	4.53, <.0001		
	Avg Temp	19.48, <.0001	238.20	0.1207		4.41, <.0001	
	Max Temp	18.39, <.0001	239.01	0.1146			4.29, <.0001
	Min/Avg	11.35, <.0001	236.58	0.1387	1.72, 0.0881	-1.41, 0.1596	
	Avg/Max	11.37, <.0001	236.55	0.1388		1.99, 0.0484	-1.73, 0.0865
	Min/Max	11.36, <.0001	236.57	0.1388	1.99, 0.0488		-1.42, 0.1582
	Min/Avg/Max	7.53, 0.0001	237.39	0.1389	-0.10, 0.9195	0.16, 0.8732	-0.20, 0.8438
OR (19)	Min Temp	3.34, 0.0698	284.59	0.023	1.83, 0.0698		
	Avg Temp	3.12, 0.0794	284.80	0.0215		1.77, 0.0794	
	Max Temp	2.95, 0.0880	284.97	0.0204			1.72 0.0880
	Min/Avg	1.75, 0.1783	285.42	0.0242	0.62, 0.5363	-0.42, 0.6785	
	Avg/Max	1.74, 0.1796	285.44	0.0241		0.73, 0.4658	-0.61, 0.5443
	Min/Max	1.74, 0.1786	285.43	0.0241	0.74, 0.4611		-0.41, 0.6816
	Min/Avg/Max	1.16, 0.3263	286.42	0.0243	0.19, 0.8514	-0.15, 0.8772	0.14, 0.8862
ND (16)	Min Temp	12.38, 0.0006	325.73	0.0802	3.52, 0.0006		
	Avg Temp	11.55, 0.0009	326.61	0.0752		3.40, 0.0009	
	Max Temp	10.74, 0.0013	327.47	0.0703			3.28, 0.0013
	Min/Avg	7.49, 0.0008	324.05	0.0961	1.80, 0.0735	-1.57, 0.1183	
	Avg/Max	7.54, 0.0008	323.96	0.0966		2.02, 0.0449	-1.83, 0.0699
	Min/Max	7.51, 0.0008	324.01	0.0963	2.01 0.0461		-1.58 0.1156
	Min/Avg/Max	5.05 0.0024	324.93	0.0976	-0.40 0.6903	0.45 0.6509	-0.49 0.6243
ME (16)	Min Temp	6.89, 0.0096	278.16	0.0463	2.63, 0.0096		
	Avg Temp	7.43, 0.0072	277.66	0.0497		2.73, 0.0072	
	Max Temp	7.89, 0.0057	277.23	0.0526			2.81, 0.0057
	Min/Avg	4.38, 0.0143	277.35	0.0585	-1.15 0.2541	1.35, 0.1790	
	Avg/Max	4.43, 0.0136	277.26	0.0591		-0.99, 0.3254	1.19, 0.2374
	Min/Max	4.41, 0.0139	277.30	0.0588	-0.97, 0.3356		1.37, 0.1725
	Min/Avg/Max	3.09, 0.0292	277.81	0.0621	0.67, 0.5065	-0.70, 0.4879	0.73, 0.4641
NH (12)	Min Temp	0.73, 0.4641	360.21	0.0158	1.51, 0.1336		
	Avg Temp	2.16, 0.1441	360.36	0.015		1.47, 0.1441	
	Max Temp	2.04, 0.1551	360.50	0.0142			1.43, 0.1551
	Min/Avg	1.22, 0.2975	361.25	0.017	0.55, 0.5853	-0.43, 0.6700	
	Avg/Max	1.18, 0.3096	361.35	0.0165		0.58, 0.5660	-0.47, 0.6404
	Min/Max	1.21, 0.3021	361.29	0.0168	0.62, 0.5384		-0.39, 0.6976
	Min/Avg/Max	1.61, 0.1894	359.51	0.0334	1.56, 0.1200	-1.55, 0.1238	1.54, 0.1263
CT (2)	Min Temp	0.04, 0.8509	848.42	0.0002	0.19, 0.8509		
	Avg Temp	0.02, 0.8932	848.47	0.0001		-0.13, 0.8932	
	Max Temp	0.32, 0.7508	848.23	0.0007			0.32, 0.7508
	Min/Avg	0.54, 0.5823	848.27	0.0076	1.03, 0.3032	-1.02, 0.3072	
	Avg/Max	1.28, 0.2823	843.93	0.0178		-1.57, 0.1197	1.59, 0.1136
	Min/Max	0.48, 0.6196	848.65	0.0068	-0.93, 0.3555		0.96, 0.3378
	Min/Avg/Max	1.10, 0.3519	844.68	0.023	-0.87, 0.3885	-1.53, 0.1294	1.48, 0.1401

Figure 8: Summary of SAS output for predictor avg temperature and Interest Over Time with onset cases

State (Onset Cases)	Variables Tested	F-Value, p-value	Coefficient Var	R-Square	T-Test, p-value	
					Avg Temp	Interest Over Time
NC (5777)	Avg Temp	234.80, <.0001	62.17	0.6231	15.32, <.0001	
	Interest Over Time	362.76, <.0001	53.71	0.7187		19.05, <.0001
	Avg Temp/Interest Over Time	298.1, <.0001	44.47	0.8088	8.15, <.0001	11.70, <.0001
AR (3786)	Avg Temp	53.67, <.0001	124.58	0.2743	7.33, <.0001	
	Interest Over Time	0.75, 0.3893	145.86	0.0052		0.86, 0.3893
	Avg Temp/Interest Over Time	30.06, <.0001	122.88	0.2928	7.69, <.0001	-2.22, 0.0277
OK (2980)	Avg Temp	214.15, <.0001	59.6	0.6013	14.63, <.0001	
	Interest Over Time	28.40, <.0001	86.16	0.1667		5.33, <.0001
	Avg Temp/Interest Over Time	109.84, <.0001	59.22	0.6091	12.63, <.0001	1.62, 0.0962
MO (2821)	Avg Temp	188.19, <.0001	75.79	0.5699	13.72, <.0001	
	Interest Over Time	41.97, <.0001	101.54	0.2281		6.48, <.0001
	Avg Temp/Interest Over Time	94.10, <.0001	75.9	0.5717	10.63, <.0001	0.76, .4501
TN (2610)	Avg Temp	86.31, <.0001	101.78	0.3782	9.29, <.0001	
	Interest Over Time	41.61, <.0001	113.51	0.2266		6.45, <.0001
	Avg Temp/Interest Over Time	44.96, <.0001	101.22	0.3894	6.13, <.0001	1.61, 0.1102
VA (1792)	Avg Temp	83.91, <.0001	105.23	0.3714	9.16, <.0001	
	Interest Over Time	75.40, <.0001	107.27	0.3468		8.68, <.0001
	Avg Temp/Interest Over Time	59.26, <.0001	98.18	0.4567	5.34, <.0001	4.70, <.0001
AL (1375)	Avg Temp	111.27, <.0001	87.39	0.4393	10.55, <.0001	
	Interest Over Time	4.691, .0321	114.84	0.032		2.17, 0.0321
	Avg Temp/Interest Over Time	56, <.0001	87.44	0.4427	10.19, <.0001	-0.92, 0.3569
GA (868)	Avg Temp	156.09, <.0001	71.85	0.5236	12.49, <.0001	
	Interest Over Time	59.55, <.0001	87.38	0.2954		7.72, <.0001
	Avg Temp/Interest Over Time	89.77, <.0001	69.29	0.5601	9.21, <.0001	3.42, .0008
IL (730)	Avg Temp	67.83, <.0001	177.76	0.3233	8.24, <.0001	
	Interest Over Time	3.24, 0.0741	141.54	0.0223		1.80, 0.0741
	Avg Temp/Interest Over Time	33.7, <.0001	118.16	0.3234	7.92, <.0001	-0.18, 0.8569
NJ (616)	Avg Temp	53.56, <.0001	90.81	0.2739	7.32, <.0001	
	Interest Over Time	6.34, 0.0129	104.26	0.0427		2.52, 0.0129
	Avg Temp/Interest Over Time	26.63, <.0001	91.11	0.2742	6.7, <.0001	0.23, 0.8212
TX (613)	Avg Temp	16.11, <.0001	76.38	0.1019	4.01, <.0001	
	Interest Over Time	0.25, 0.6209	80.53	0.0017		-0.50, 0.6209
	Avg Temp/Interest Over Time	9.89, <.0001	75.74	0.123	4.42, <.0001	-1.84, 0.0672
SC (338)	Avg Temp	95.30, <.0001	84.55	0.4016	9.76, <.0001	
	Interest Over Time	15.30, 0.0001	103.8503	0.0972		3.91, 0.0001
	Avg Temp/Interest Over Time	49.08, <.0001	84.22	0.4104	8.65, <.0001	1.45, 0.1485
MS (242)	Avg Temp	22.21, <.0001	197.62	0.1353	4.71, <.0001	
	Interest Over Time	0.69, 0.4060	212	0.0049		0.83, 0.4060
	Avg Temp/Interest Over Time	11.16, <.0001	198.17	0.1366	4.64, <.0001	-0.047, 0.6386
FL (209)	Avg Temp	12.34, 0.0006	96.32	0.0799	3.51, 0.0006	
	Interest Over Time	0.36, 0.5503	100.23	0.0025		0.6, 0.5503
	Avg Temp/Interest Over Time	6.18, 0.0027	96.63	0.0806	3.46, 0.0007	-0.31, 0.7608
AZ (180)	Avg Temp	11.18, 0.0011	107.76	0.0954	3.34, 0.0011	
	Interest Over Time	0.17, 0.6791	113.21	0.0016		0.41, 0.6791
	Avg Temp/Interest Over Time	5.55, 0.0051	108.26	0.0956	3.30, 0.0013	-0.15, 0.8831
KY (175)	Avg Temp	18.21, <.0001	239.59	0.1137	4.27, <.0001	
	Interest Over Time	2.66, 0.1049	252.14	0.0184		1.63, 0.1049
	Avg Temp/Interest Over Time	9.1, 0.0002	240.36	0.1143	3.91, <.0001	-0.31, 0.7586

IN (171)	Avg Temp	56.92, <.0001	142.79	0.2862	7.54, <.0001	
	Interest Over Time	0.09, 0.7660	168.9509	0.0006		0.3, 0.7660
	Avg Temp/Interest Over Time	28.72, <.0001	142.96322	0.2895	7.57, <.0001	-0.81, 0.4193
NY (136)	Avg Temp	31.51, <.0001	140.51	0.1816	5.61, <.0001	
	Interest Over Time	14.41, 0.0002	147.99316	0.0921		3.80, 0.0002
	Avg Temp/Interest Over Time	18.54, <.0001	138.7	0.2082	4.55, <.0001	2.18, 0.0312
NE (113)	Avg Temp	59.76, <.0001	222.33	0.2962	7.73, <.0001	
	Interest Over Time	2.19, 0.1413	158.24	0.0152		1.48, 0.1413
	Avg Temp/Interest Over Time	30.01, <.0001	134.02	0.2986	7.55, <.0001	-0.69, 0.4894
DE (101)	Avg Temp	18.07, <.0001	182.46	0.1129	4.25, <.0001	
	Interest Over Time	0.01, 0.917	193.72	0.0001		-0.10, 0.9170
	Avg Temp/Interest Over Time	9.39, 0.0001	182.63	0.1175	4.33, <.0001	-0.86, 0.3923
IA (82)	Avg Temp	59.9, <.0001	130.39	0.2967	7.74, <.0001	
	Interest Over Time	0.19, 0.6676	155.37	0.0013		-0.43, 0.6676
	Avg Temp/Interest Over Time	31.51, <.0001	129.71	0.3089	7.92, <.0001	-1.58, 0.1165
WI (76)	Avg Temp	23.92, <.0001	167.64	0.1442	4.89, <.0001	
	Interest Over Time	0.65, 0.4222	180.8	0.0045		0.81, 0.4222
	Avg Temp/Interest Over Time	12.2, <.0001	167.91	0.1475	4.86, <.0001	0.74, 0.4598
MN (75)	Avg Temp	29.56, <.0001	163.19	0.1723	5.44, <.0001	
	Interest Over Time	0.13, 0.7183	179.29	0.0009		0.36, 0.7183
	Avg Temp/Interest Over Time	14.78, <.0001	163.67	0.1733	5.42, <.0001	-0.41, 0.6790
MA (61)	Avg Temp	15.08, 0.0002	173.81	0.096	3.88, 0.0002	
	Interest Over Time	0.82, 0.3657	182.28	0.0058		0.91, 0.3657
	Avg Temp/Interest Over Time	7.49, <.0001	85.16	0.096	3.75, <.0001	-0.05, 0.9586
WV (56)	Avg Temp	25.99, <.0001	148.76	0.1547	5.10, <.0001	
	Interest Over Time	5.13, 0.0250	158.96	0.0349		2.26, 0.0250
	Avg Temp/Interest Over Time	14.41, <.0001	147.95	0.1697	4.79, <.0001	1.60, 0.1127
UT (35)	Avg Temp	7.80, 0.0059	224.221	0.0521	2.79, 0.0059	
	Interest Over Time	0.08, 0.7748	230.23	0.0006		0.29, 0.7748
	Avg Temp/Interest Over Time	3.89, 0.0228	225	0.0522	2.77, 0.0063	-0.15, 0.8843
MT (31)	Avg Temp	4.62, 0.0334	297.96	0.0315	2.15, 0.0334	
	Interest Over Time	4.15, 0.0434	298.44	0.0284		2.04, 0.0434
	Avg Temp/Interest Over Time	4.19, 0.0171	295.2	0.056	2.03, 0.0440	1.92, 0.0574
LA (30)	Avg Temp	4.72, 0.315	249.84	0.0322	2.17, 0.0315	
	Interest Over Time	0.01, 0.9103	253.95	0.0001		0.11, 0.9103
	Avg Temp/Interest Over Time	2.39, 0.0957	250.65	0.0327	2.18, 0.0308	-0.29, 0.7728
SD (29)	Avg Temp	19.48, <.0001	238.20	0.1207	4.41, <.0001	
	Interest Over Time	1.36, 0.2461	252.8089	0.0095		1.16, 0.2461
	Avg Temp/Interest Over Time	9.70, 0.0001	239.00579	0.1209	4.23, <.0001	0.20, 0.8407
OR (19)	Avg Temp	3.12, 0.0794	284.8	0.0215	1.77, 0.0794	
	Interest Over Time	0.07, 0.7846	287.84	0.0005		-.27, 0.7846
	Avg Temp/Interest Over Time	1.57, 0.2117	285.77	0.0218	1.75, 0.0822	-0.20, 0.8415
ND (16)	Avg Temp	11.55, 0.0009	326.61	0.0752	3.40, 0.0009	
	Interest Over Time	0.19, 0.6660	339.41	0.0013		0.43, 0.6660
	Avg Temp/Interest Over Time	3.7, 0.0271	278.61	0.0499	2.71, 0.0075	-0.16, 0.8721
ME (16)	Avg Temp	7.43, 0.0072	277.66	0.0497	2.73, 0.0072	
	Interest Over Time	0.04, 0.8456	284.79	0.0003		0.20, 0.8456
	Avg Temp/Interest Over Time	3.7, 0.0271	278.61	0.0499	2.71, 0.0075	-0.16, 0.8721
NH (12)	Avg Temp	2.16, 0.1441	360.36	0.015	1.47, 0.1441	
	Interest Over Time	4.94, 0.0279	356.94	0.0336		2.22, 0.0279
	Avg Temp/Interest Over Time	3.13, 0.0469	356.55	0.0425	1.14, 0.2548	2.01, 0.0461
CT (2)	Avg Temp	0.02, 0.8932	848.47	0.0001	-0.13, 0.8932	
	Interest Over Time	7.09, 0.0087	828.11	0.0475		2.66, 0.0087
	Avg Temp/Interest Over Time	3.65, 0.0284	830.29	0.0493	-0.50, 0.6148	2.70, 0.0078

Figure 9: Summary of SAS output for predictor temperature and Interest Over Time with onset cases

State (Onset Cases)	Variables Tested	F-Value, p-value	Coefficient Var	R-Square	T-Test, p-value			
					Min Temp	Avg Temp	Max Temp	Interest Over Time
NC (5777)	Avg Min Temp/Interest Over Time	302.84, <.0001	44.16	0.8112	8.31, <.0001			11.93, <.0001
	Avg Temp/Interest Over Time	298.1, <.0001	44.47	0.8088		8.15, <.0001		11.70, <.0001
	Avg Max Temp/Interest Over Time	289.55, <.0001	44.97	0.8042			7.85, <.0001	11.59, <.0001
	All Variables	149.93, <.0001	44.40	0.8118	0.52, 0.6025	-0.44, 0.6586	0.42, 0.6731	11.76, <.0001
AR (3786)	Avg Min Temp/Interest Over Time	31.23, <.0001	122.17	0.307	7.84, <.0001			-2.30, 0.0228
	Avg Temp/Interest Over Time	30.06, <.0001	122.88	0.2928		7.69, <.0001		-2.22, 0.027
	Avg Max Temp/Interest Over Time	28.39, <.0001	123.92	0.2871			7.47, <.0001	-2.10, 0.0375
	All Variables	15.85, <.0001	122.49	0.3132	0.87, 0.3847	-0.81, 0.4215	0.78, 0.4351	-2.30, 0.0227
OK (2980)	Avg Min Temp/Interest Over Time	112.97, <.0001	58.71	0.6157	12.84, <.0001			1.53, 0.1277
	Avg Temp/Interest Over Time	109.84, <.0001	59.22	0.6091		12.63, <.0001		1.62, 0.0962
	Avg Max Temp/Interest Over Time	103.74, <.0001	60.25	0.5954			12.22, <.0001	1.88, 0.0622
	All Variables	56.27, <.0001	58.94	0.6182	0.93, 0.3541	-0.86, 0.3935	0.85, 0.3995	1.42, 0.1591
MO (2821)	Avg Min Temp/Interest Over Time	99.95, <.0001	74.59	0.5864	11.05, <.0001			0.51, 0.6084
	Avg Temp/Interest Over Time	94.10, <.0001	75.90	0.5717		10.63, <.0001		0.76, 0.4501
	Avg Max Temp/Interest Over Time	87.53, <.0001	77.47	0.5539			10.15, <.0001	1.05, 0.2954
	All Variables	52.37, <.0001	73.78	0.6011	0.78, 0.4380	-0.64, 0.5246	0.57, 0.5721	0.26, 0.7915
TN (2610)	Avg Min Temp/Interest Over Time	46.77, <.0001	100.44	0.3988	6.36, <.0001			1.63, 0.1057
	Avg Temp/Interest Over Time	44.96, <.0001	101.22	0.3894		6.13, <.0001		1.61, 0.1102
	Avg Max Temp/Interest Over Time	42.57, <.0001	102.28	0.3765			5.82, <.0001	1.69, 0.0931
	All Variables	23.65, <.0001	100.64	0.4049	-0.10, 0.9200	0.18, 0.8581	-0.21, 0.8310	1.82, 0.0711
VA (1792)	Avg Min Temp/Interest Over Time	59.79, <.0001	97.98	0.4589	5.40, <.0001			4.71, <.0001
	Avg Temp/Interest Over Time	59.26, <.0001	98.18	0.4567		5.34, <.0001		4.70, <.0001
	Avg Max Temp/Interest Over Time	58.17, <.0001	98.60	0.4521			5.20, <.0001	4.77, <.0001
	All Variables	30.87, <.0001	97.63	0.4704	-1.66, 0.0986	1.71, 0.0900	-1.72, 0.0883	4.74, <.0001
AL (1375)	Avg Min Temp/Interest Over Time	60.26 <.0001	86.01	0.4608	10.59 <.0001			-1.00 0.3195
	Avg Temp/Interest Over Time	56, <.0001	87.44	0.4427		10.19, <.0001		-0.92, 0.3569
	Avg Max Temp/Interest Over Time	49.85 <.0001	89.65	0.4142			9.59 <.0001	-0.76 0.4497
	All Variables	30.85 <.0001	85.86	0.4703	-0.31 0.7550	0.42 0.6784	-0.46 0.6479	-0.93 0.3553
GA (868)	Avg Min Temp/Interest Over Time	91.87 <.0001	68.84	0.5658	9.37 <.0001			3.67 0.0003
	Avg Temp/Interest Over Time	89.77, <.0001	69.29	0.5601		9.21, <.0001		3.42, 0.0008
	Avg Max Temp/Interest Over Time	84.79, <.0001	70.39	0.546			8.82, <.0001	3.30, 0.0012
	All Variables	45.58, <.0001	69.21	0.5674	-0.56, 0.5740	0.63, 0.5291	-0.64, 0.5229	3.57, 0.0005
IL (730)	Avg Min Temp/Interest Over Time	33.80, <.0001	118.10	0.3241	7.93, <.0001			-0.19, 0.8506
	Avg Temp/Interest Over Time	33.7, <.0001	118.16	0.3234		7.92, <.0001		-0.18, 0.8569
	Avg Max Temp/Interest Over Time	33.22, <.0001	118.43	0.3203			7.86, <.0001	-0.15, 0.8780
	All Variables	16.78, <.0001	118.80	0.3257	0.58, 0.5648	-0.55, 0.5855	0.55, 0.5818	-0.19, 0.8473
NJ (616)	Avg Min Temp/Interest Over Time	26.46, <.0001	91.19	0.2729	6.68, <.0001			0.31, 0.7532
	Avg Temp/Interest Over Time	26.63, <.0001	91.11	0.2742		6.7, <.0001		0.23, 0.8212
	Avg Max Temp/Interest Over Time	26.47, <.0001	91.19	0.273			6.68, <.0001	0.17, 0.8640
	All Variables	13.13 <.0001	91.76	0.2742	-0.03 0.9768	0.05 0.9632	-0.03 0.9762	0.22 0.8251
TX (613)	Avg Min Temp/Interest Over Time	9.68 0.0001	75.84	0.1207	4.37 <.0001			-1.87 0.0642
	Avg Temp/Interest Over Time	9.89, <.0001	75.74	0.123		4.42, <.0001		-0.50, 0.6209
	Avg Max Temp/Interest Over Time	9.87, <.0001	75.75	0.1228			4.41, <.0001	-1.79, 0.0751
	All Variables	4.93, 0.0010	76.24	0.1241	0.37, 0.7112	-0.36, 0.7174	0.38, 0.7036	-1.83, 0.0692
SC (338)	Avg Min Temp/Interest Over Time	49.67, <.0001	84.01	0.4133	8.72, <.0001			1.54, 0.1263
	Avg Temp/Interest Over Time	49.08, <.0001	84.22	0.4104		8.65, <.0001		1.45, 0.1485
	Avg Max Temp/Interest Over Time	47.24, <.0001	84.88	0.4012			8.46, <.0001	1.42, 0.1573
	All Variables	24.48, <.0001	84.62	0.4134	0.10, 0.9234	-0.05, 0.9616	0.05, 0.9621	1.52, 0.1318
MS (242)	Avg Min Temp/Interest Over Time	11.79, <.0001	197.41	0.1432	4.77, <.0001			-0.48, 0.6297
	Avg Temp/Interest Over Time	11.16, <.0001	198.17	0.1366		4.64, <.0001		-0.047, 0.6386
	Avg Max Temp/Interest Over Time	10.25, <.0001	199.28	0.1269			4.44, <.0001	-0.42, 0.6742
	All Variables	7.06, <.0001	195.83	0.1688	-1.77, 0.0796	1.82, 0.0712	-1.84, 0.0672	-0.87, 0.3883
FL (209)	Avg Min Temp/Interest Over Time	6.23, 0.0026	96.60	0.0811	3.47, 0.0007			-0.27, 0.7893
	Avg Temp/Interest Over Time	6.18, 0.0027	96.63	0.0806		3.46, 0.0007		-0.31, 0.7608
	Avg Max Temp/Interest Over Time	5.93, 0.0034	96.79	0.0775			3.39, 0.0009	-0.32, 0.7477
	All Variables	3.13, 0.0167	97.21	0.0827	-0.46, 0.6443	0.49, 0.6265	-0.49, 0.6275	-0.28, 0.7799
AZ (180)	Avg Min Temp/Interest Over Time	5.24, 0.0067	108.55	0.0908	3.21, 0.0018			-0.10, 0.9221
	Avg Temp/Interest Over Time	5.55, 0.0051	108.26	0.0956		3.30, 0.0013		-0.15, 0.8831
	Avg Max Temp/Interest Over Time	5.72, 0.0044	108.11	0.0982			3.35, 0.0011	-0.18, 0.8556
	All Variables	2.85, 0.0277	109.07	0.0995	0.23, 0.8210	-0.23, 0.8152	0.26, 0.7983	-0.20, 0.8390
KY (175)	Avg Min Temp/Interest Over Time	9.77, 0.0001	239.35	0.1218	4.07, <.0001			-0.36, 0.7189
	Avg Temp/Interest Over Time	9.1, 0.0002	240.36	0.1143		3.91, <.0001		-0.31, 0.7586
	Avg Max Temp/Interest Over Time	8.41, 0.0004	241.40	0.1066			3.73, 0.0003	-0.23, 0.8160
	All Variables	6.66, <.0001	235.63	0.1609	2.24, 0.0270	-2.18, 0.0312	2.14, 0.0340	-0.11, 0.9118

IN (171)	Avg Min Temp/Interest Over Time	29.95, <.0001	142.09	0.2982	7.73, <.0001			-0.92, 0.3575
	Avg Temp/Interest Over Time	28.72, <.0001	142.96	0.2895		7.57, <.0001		-0.81, 0.4193
	Avg Max Temp/Interest Over Time	27.32, <.0001	143.98	0.2793			7.38, <.0001	-0.70, 0.4821
	All Variables	15.27, <.0001	142.37	0.3053	0.17, 0.8647	-0.10, 0.9217	0.07, 0.9479	-1.09, 0.2775
NY (136)	Avg Min Temp/Interest Over Time	17.96, <.0001	139.15	0.203	4.43, <.0001			2.29, 0.0235
	Avg Temp/Interest Over Time	18.54, <.0001	138.70	0.2082		4.55, <.0001		2.18, 0.0312
	Avg Max Temp/Interest Over Time	18.92, <.0001	138.40	0.2116			4.62, <.0001	2.09, 0.0387
	All Variables	9.67, <.0001	138.85	0.2177	-0.75, 0.4530	0.73, 0.4662	-0.69, 0.4905	1.94, 0.0538
NE (113)	Avg Min Temp/Interest Over Time	30.88, <.0001	133.44	0.3046	7.66, <.0001			-0.76, 0.4486
	Avg Temp/Interest Over Time	30.01, <.0001	134.02	0.2986		7.55, <.0001		-0.69, 0.4894
	Avg Max Temp/Interest Over Time	28.76, <.0001	134.86	0.2897			7.38, <.0001	-0.60, 0.5471
	All Variables	16.00, <.0001	133.37	0.3152	-1.20, 0.2303	1.26, 0.2101	-1.28, 0.2033	-0.86, 0.3887
DE (101)	Avg Min Temp/Interest Over Time	9.43, 0.0001	182.58	0.118	4.34, <.0001			-0.87, 0.3883
	Avg Temp/Interest Over Time	9.39, 0.0001	182.63	0.1175		4.33, <.0001		-0.86, 0.3923
	Avg Max Temp/Interest Over Time	9.27, 0.0002	182.77	0.1162			4.30, <.0001	-0.84, 0.4000
	All Variables	4.70, 0.0014	183.78	0.1191	0.43, 0.6644	-0.41, 0.6792	0.42, 0.6786	-0.84, 0.4050
IA (82)	Avg Min Temp/Interest Over Time	32.52, <.0001	129.07	0.3156	8.05, <.0001			-1.62, 0.1065
	Avg Temp/Interest Over Time	31.51, <.0001	129.71	0.3089		7.92, <.0001		-1.58, 0.1165
	Avg Max Temp/Interest Over Time	30.22, <.0001	130.54	0.3			7.76, <.0001	-1.53, 0.1290
	All Variables	16.91, <.0001	128.88	0.3274	-1.10, 0.2712	1.17, 0.2446	-1.20, 0.2335	-1.69, 0.0940
WI (76)	Avg Min Temp/Interest Over Time	12.14, <.0001	167.97	0.1469	4.85, <.0001			0.72, 0.4715
	Avg Temp/Interest Over Time	12.2, <.0001	167.91	0.1475		4.86, <.0001		0.74, 0.4598
	Avg Max Temp/Interest Over Time	12.17, <.0001	167.94	0.1472			4.86, <.0001	0.76, 0.4486
	All Variables	6.92, <.0001	167.26	0.1661	1.76, 0.0806	-1.75, 0.0819	1.76, 0.0804	0.86, 0.3924
MN (75)	Avg Min Temp/Interest Over Time	14.47, <.0001	163.97	0.1703	5.36, <.0001			-0.43, 0.6711
	Avg Temp/Interest Over Time	14.78, <.0001	163.67	0.1733		5.42, <.0001		-0.41, 0.6790
	Avg Max Temp/Interest Over Time	14.94, <.0001	163.51	0.1749			5.45, <.0001	-0.40, 0.6900
	All Variables	7.42, <.0001	164.58	0.1759	-0.32, 0.7480	0.31 0.7544	-0.29, 0.7738	-0.36, 0.7215
MA (61)	Avg Min Temp/Interest Over Time	7.73, 0.0007	174.16	0.0988	3.82, 0.0002			-0.05, 0.9567
	Avg Temp/Interest Over Time	7.49, <.0001	174.43	0.096		3.75, <.0001		-0.05, 0.9586
	Avg Max Temp/Interest Over Time	7.18, 0.0011	174.77	0.0925			3.67, 0.0003	-0.04, 0.9692
	All Variables	4.01, 0.0041	174.95	0.1035	-0.51, 0.6122	0.55, 0.5829	-0.57, 0.5684	-0.04, 0.9713
WV (56)	Avg Min Temp/Interest Over Time	14.96, <.0001	147.48	0.175	4.89, <.0001			1.61, 0.1094
	Avg Temp/Interest Over Time	14.41, <.0001	147.95	0.1697		4.79, <.0001		1.60, 0.1127
	Avg Max Temp/Interest Over Time	13.69, <.0001	148.59	0.1626			4.64, <.0001	1.59, 0.1135
	All Variables	8.03, <.0001	147.40	0.1877	-1.22, 0.2245	1.26, 0.2084	-1.28, 0.2022	1.80, 0.0733
UT (35)	Avg Min Temp/Interest Over Time	3.77, 0.0253	225.17	0.0508	2.73, 0.0071			-0.13, 0.8959
	Avg Temp/Interest Over Time	3.89, 0.0228	225.00	0.0522		2.77, 0.0063		-0.15, 0.8843
	Avg Max Temp/Interest Over Time	3.96, 0.0211	224.88	0.0532			2.80, 0.0058	-0.16, 0.8754
	All Variables	2.14, 0.0793	225.93	0.058	0.71, 0.4780	-0.73, 0.4662	0.76, 0.4502	-0.25, 0.8006
MT (31)	Avg Min Temp/Interest Over Time	4.39, 0.0142	294.81	0.0586	2.13, 0.0353			1.89, 0.0605
	Avg Temp/Interest Over Time	4.19, 0.0171	295.20	0.056		2.03, 0.0440		1.92, 0.0574
	Avg Max Temp/Interest Over Time	5.16, 0.0069	293.29	0.0682			2.45, 0.0153	1.86, 0.0645
	All Variables	3.59, 0.0081	291.33	0.0937	1.10, 0.2750	-1.56, 0.1217	1.95, 0.0536	1.63, 0.1043
LA (30)	Avg Min Temp/Interest Over Time	2.35, 0.0993	250.72	0.0322	2.16, 0.0322			-0.32, 0.7514
	Avg Temp/Interest Over Time	2.39, 0.0957	250.65	0.0327		2.18, 0.0308		-0.29, 0.7728
	Avg Max Temp/Interest Over Time	2.37, 0.0969	250.67	0.0326			2.18, 0.0312	-0.25, 0.8016
	All Variables	1.27, 0.2866	252.14	0.0351	-0.59, 0.5595	0.59, 0.5562	-0.58, 0.5623	-0.29, 0.7729
SD (29)	Avg Min Temp/Interest Over Time	10.22, <.0001	238.23	0.1266	4.35, <.0001			0.15, 0.8818
	Avg Temp/Interest Over Time	9.70, 0.0001	239.01	0.1209		4.23, <.0001		0.20, 0.8407
	Avg Max Temp/Interest Over Time	9.16, 0.0002	239.80	0.115			4.10, <.0001	0.25, 0.7997
	All Variables	5.61, 0.0003	238.24	0.1389	-0.10, 0.9188	0.16, 0.8727	-0.20, 0.8436	0.04, 0.9695
OR (19)	Avg Min Temp/Interest Over Time	1.68, 0.1895	285.55	0.0233	1.81, 0.0718			-0.22, 0.8233
	Avg Temp/Interest Over Time	1.57, 0.2117	285.77	0.0218		1.75, 0.0822		-0.20, 0.8415
	Avg Max Temp/Interest Over Time	1.48, 0.2304	285.94	0.0206			1.70, 0.0913	-0.19, 0.8505
	All Variables	0.89, 0.4726	287.36	0.0249	0.23, 0.8196	-0.19, 0.8459	0.18, 0.8556	-0.30, 0.7653
ND (16)	Avg Min Temp/Interest Over Time	6.15, 0.0027	326.88	0.0802	3.48, 0.0007			-0.05, 0.9621
	Avg Temp/Interest Over Time	5.74, 0.0040	327.77	0.0752		3.36, 0.0010		-0.06, 0.9529
	Avg Max Temp/Interest Over Time	-0.06, 0.9529	328.63	0.0704			3.24, 0.0015	-0.06, 0.9502
	All Variables	3.76 0.0062	326.09	0.0977	-0.38, 0.7019	0.44, 0.6623	-0.48, 0.6355	0.10, 0.9234
ME (16)	Avg Min Temp/Interest Over Time	3.43, 0.0351	279.12	0.0464	2.61, 0.0100			-0.13, 0.8952
	Avg Temp/Interest Over Time	3.7, 0.0271	278.61	0.0499		2.71, 0.0075		-0.16, 0.8721
	Avg Max Temp/Interest Over Time	3.93, 0.0218	278.18	0.0529			2.80, 0.0059	-0.19, 0.8516
	All Variables	2.33, 0.0594	278.71	0.0627	0.68, 0.4945	-0.71, 0.4759	0.75, 0.4522	-0.31, 0.7585
NH (12)	Avg Min Temp/Interest Over Time	3.20, 0.0437	356.37	0.0434	1.20, 0.2308			2.02, 0.0454
	Avg Temp/Interest Over Time	3.13, 0.0469	356.55	0.0425		1.14, 0.2548		2.01, 0.0461
	Avg Max Temp/Interest Over Time	3.06, 0.0499	356.71	0.0416			1.09, 0.2787	2.01, 0.0464
	All Variables	2.29, 0.0623	355.43	0.0619	1.55, 0.1243	-1.52, 0.1296	1.51, 0.1338	2.06, 0.0415
CT (2)	Avg Min Temp/Interest Over Time	3.56 0.0311	830.83	0.048	-0.27, 0.7875			2.66, 0.0087
	Avg Temp/Interest Over Time	3.65, 0.0284	830.29	0.0493		-0.50, 0.6148		2.70, 0.0078
	Avg Max Temp/Interest Over Time	3.52, 0.0322	831.03	0.0476			-0.07, 0.9443	2.63, 0.0094
	All Variables	2.89, 0.0247	824.09	0.0767	-1.41, 0.1600	-1.48, 0.1422	1.91, 0.0578	2.84, 0.0051

Figure 10: Summary of SAS output for predictor avg temperature and Interest Over Time with onset cases 2008-2015

State (Onset Cases)	Variables Tested	F-Value, p-value	Coefficient Var	R-Square	T-Test, p-value	
					Avg Temp	Interest Over Time
NC (5777)	Avg Temp	189.00, <.0001	59.04	0.6407	13.75, <.0001	
	Interest Over Time	222.02, <.0001	55.99	0.6769		14.90, <.0001
	Avg Temp/Interest Over Time	174.75, <.0001	47.56	**0.769**	6.47, <.0001	7.64, <.0001
AR (3786)	Avg Temp	56.35, <.0001	104.57	0.3471	7.51, <.0001	
	Interest Over Time	20.52, <.0001	118.45	0.1622		4.53, <.0001
	Avg Temp/Interest Over Time	28.07, <.0001	104.96	**0.3484**	5.48, <.0001	0.46, 0.6434
OK (2980)	Avg Temp	207.83, <.0001	52.70	0.6622	14.42, <.0001	
	Interest Over Time	54.89, <.0001	73.61	0.3412		7.41, <.0001
	Avg Temp/Interest Over Time	104.92, <.0001	52.62	**0.6665**	10.12, <.0001	1.16, 0.2496
MO (2821)	Avg Temp	226.52, <.0001	59.96	0.6812	15.05, <.0001	
	Interest Over Time	127.11 <.0001	71.62	0.5453		11.27 <.0001
	Avg Temp/Interest Over Time	151.09, <.0001	54.19	**0.7421**	8.95, <.0001	4.98, <.0001
TN (2610)	Avg Temp	85.32, <.0001	87.65	0.446	9.24, <.0001	
	Interest Over Time	88.25, <.0001	86.98	0.4543		9.39, <.0001
	Avg Temp/Interest Over Time	58.15, <.0001	81.49	**0.5255**	3.97, 0.0001	4.20, <.0001
VA (1792)	Avg Temp	72.33, <.0001	97.70	0.4056	8.50, <.0001	
	Interest Over Time	169.22, <.0001	78.64	0.6149		13.01, <.0001
	Avg Temp/Interest Over Time	98.24, <.0001	75.14	**0.6517**	3.33, 0.0012	8.61, <.0001
AL (1375)	Avg Temp	92.90, <.0001	81.13	**0.4671**	9.64, <.0001	
	Interest Over Time	11.67, 0.0009	105.48	0.0992		3.42, 0.0009
	Avg Temp/Interest Over Time	46.03, <.0001	81.51	**0.4671**	8.52, <.0001	-0.13, 0.8993
GA (868)	Avg Temp	115.22, <.0001	71.05	0.5208	10.73, <.0001	
	Interest Over Time	81.12, <.0001	77.25	0.4335		9.01, <.0001
	Avg Temp/Interest Over Time	68.06, <.0001	68.05	**0.5645**	5.62, <.0001	3.25, 0.0016
IL (730)	Avg Temp	76.16, <.0001	96.51	0.4181	8.73, <.0001	
	Interest Over Time	36.89, <.0001	108.97	0.2582		6.07, <.0001
	Avg Temp/Interest Over Time	42.34, <.0001	94.58	**0.4464**	5.98, <.0001	2.32, 0.0224
NJ (616)	Avg Temp	49.16, <.0001	78.66	0.3169	7.01, <.0001	
	Interest Over Time	11.47, 0.0010	90.40	0.0976		3.39, 0.0010
	Avg Temp/Interest Over Time	24.56, <.0001	78.92	**0.3187**	5.84, <.0001	0.54, 0.5918
TX (613)	Avg Temp	10.72, 0.0014	66.57	0.0918	3.27 0.0014	
	Interest Over Time	4.97, 0.0279	68.27	0.0448		2.23, 0.0279
	Avg Temp/Interest Over Time	5.56, 0.0051	66.74	**0.0957**	2.43 0.0167	0.67, 0.5030
SC (338)	Avg Temp	64.94, <.0001	85.47	0.3799	8.06, <.0001	
	Interest Over Time	30.09, <.0001	95.79	0.2211		5.49, <.0001
	Avg Temp/Interest Over Time	35.69, <.0001	84.14	**0.4047**	5.69, <.0001	2.09, 0.0390
MS (242)	Avg Temp	23.87, <.0001	163.67	0.1838	4.89, <.0001	
	Interest Over Time	2.52, 0.1151	179.05	0.0233		1.59, 0.1151
	Avg Temp/Interest Over Time	12.09, <.0001	164.11	**0.1871**	4.6, <.0001	-0.66, 0.5117
FL (209)	Avg Temp	15.98, 0.0001	93.04	0.131	4.00, 0.0001	
	Interest Over Time	0.76, 0.3846	99.45	0.0071		0.87, 0.3846
	Avg Temp/Interest Over Time	8.34, 0.0004	93.16	**0.137**	3.98, 0.0001	-0.86, 0.3932
AZ (180)*	Avg Temp	3.51, 0.0652	99.08	0.0478	1.87, 0.0652	
	Interest Over Time	0.11, 0.7383	101.46	0.0016		0.34, 0.7383
	Avg Temp/Interest Over Time	1.80, 0.1726	99.70	**0.0497**	1.87, 0.0660	-0.37, 0.7113
KY (175)	Avg Temp	18.65, <.0001	202.31	0.1496	4.32, <.0001	
	Interest Over Time	8.20, 0.0051	211.37	0.0718		2.86, 0.0051
	Avg Temp/Interest Over Time	9.24, 0.0002	203.27	**0.1497**	3.10, 0.0025	0.08 0.9365
IN (171)	Avg Temp	69.27, <.0001	111.29	0.3952	8.32, <.0001	
	Interest Over Time	11.73, 0.0009	135.79	0.0996		3.42, 0.0009
	Avg Temp/Interest Over Time	35.22, <.0001	111.24	**0.4015**	7.28, <.0001	1.05, 0.2956

NY (136)	Avg Temp	39.68, <.0001	107.74	0.2724	6.30, <.0001	
	Interest Over Time	51.40, <.0001	103.66	0.3266		7.17, <.0001
	Avg Temp/Interest Over Time	32.33, <.0001	99.84	**0.3812**	3.04, 0.0030	4.30, <.0001
NE (113)	Avg Temp	59.50, <.0001	117.73	0.3595	7.71, <.0001	
	Interest Over Time	8.44, 0.0045	141.58	0.0738		2.91, 0.0045
	Avg Temp/Interest Over Time	29.50, <.0001	118.27	**0.3598**	6.85, <.0001	0.20, 0.8416
DE (101)	Avg Temp	20.51 <.0001	146.83	0.1621	4.53 <.0001	
	Interest Over Time	0.08 0.7752	160.35	0.0008		-0.29 0.7752
	Avg Temp/Interest Over Time	11.64 <.0001	145.82	**0.1815**	4.81 <.0001	-1.57 0.1183
IA (82)	Avg Temp	48.07, <.0001	122.19	0.312	6.93, <.0001	
	Interest Over Time	3.07, 0.0829	145.22	0.0281		1.75, 0.0829
	Avg Temp/Interest Over Time	23.82, <.0001	122.76	**0.3121**	6.58, <.0001	0.09, 0.9285
WI (76)	Avg Temp	23.50, <.0001	141.97	0.1815	4.85, <.0001	
	Interest Over Time	3.09, 0.0815	154.68	0.0284		1.76, 0.0815
	Avg Temp/Interest Over Time	12.00, <.0001	142.24	**0.186**	4.51, <.0001	0.77, 0.4451
MN (75)	Avg Temp	25.41, <.0001	149.76	0.1934	5.04, <.0001	
	Interest Over Time	1.26, 0.2646	165.77	0.0117		1.12, 0.2646
	Avg Temp/Interest Over Time	12.71, <.0001	150.33	**0.1949**	4.89, <.0001	-0.44, 0.6581
MA (61)	Avg Temp	9.29, 0.0029	211.14	0.0806	3.05, 0.0029	
	Interest Over Time	0.01, 0.9071	220.18	0.0001		0.12, 0.9071
	Avg Temp/Interest Over Time	5.36, 0.0060	210.74	**0.0927**	3.27, 0.0014	-1.18 0.2387
WV (56)	Avg Temp	14.90, 0.0002	160.65	0.1233	3.86, 0.0002	
	Interest Over Time	3.49, 0.0645	168.82	0.0319		1.87, 0.0645
	Avg Temp/Interest Over Time	7.56, 0.0009	161.18	**0.1258**	3.36, 0.0011	0.55, 0.5802
UT (35)	Avg Temp	7.18, 0.0086	191.88	0.0634	2.68, 0.0086	
	Interest Over Time	0.55, 0.4587	197.75	0.0052		0.74, 0.4587
	Avg Temp/Interest Over Time	3.57, 0.0316	192.76	**0.0637**	2.56, 0.0119	0.17, 0.8629
MT (31)	Avg Temp	4.43, 0.0377	276.49	0.0401	2.10, 0.0377	
	Interest Over Time	19.03, <.0001	259.84	0.1522		4.36, <.0001
	Avg Temp/Interest Over Time	10.32, <.0001	259.21	**0.1643**	1.23, 0.2207	3.95, 0.0001
LA (30)	Avg Temp	5.59, 0.0199	243.88	0.0501	2.36, 0.0199	
	Interest Over Time	4.39, 0.0385	245.20	0.0398		2.10, 0.0385
	Avg Temp/Interest Over Time	3.63, 0.0299	243.16	**0.0647**	1.67, 0.0978	1.28, 0.2041
SD (29)	Avg Temp	16.76 <.0001	240.81	0.1366	4.09 <.0001	
	Interest Over Time	0.19, 0.6671	258.93	0.0018		0.43, 0.6671
	Avg Temp/Interest Over Time	8.59, 0.0004	241.40	**0.1406**	4.12, <.0001	-0.70, 0.4861
OR (19)	Avg Temp	2.56, 0.1128	292.26	0.0235	1.60, 0.1128	
	Interest Over Time	0.22, 0.6381	295.46	0.0021		-0.47, 0.6381
	Avg Temp/Interest Over Time	1.38, 0.2564	293.34	**0.0256**	1.59, 0.1146	-0.47, 0.6397
ND (16)	Avg Temp	10.26, 0.0018	290.43	0.0883	3.20, 0.0018	
	Interest Over Time	0.39, 0.5326	303.60	0.0037		0.63, 0.5326
	Avg Temp/Interest Over Time	5.09, 0.0077	291.77	**0.0885**	3.12, 0.0023	0.16, 0.8770
ME (16)	Avg Temp	7.82, 0.0061	233.58	0.0687	2.80, 0.0061	
	Interest Over Time	2.06, 0.1544	239.73	0.019		1.43, 0.1544
	Avg Temp/Interest Over Time	4.34, 0.0154	233.71	**0.0764**	2.55, 0.0121	0.94, 0.3513
NH (12)	Avg Temp	1.45, 0.2312	326.46	0.0135	1.20, 0.2312	
	Interest Over Time	4.35, 0.0393	322.14	0.0395		2.09, 0.0393
	Avg Temp/Interest Over Time	2.57, 0.0817	322.46	**0.0466**	0.89, 0.3772	1.91, 0.0590
CT (2)	Avg Temp	0.54, 0.4647	1041.48	0.0051	-0.73, 0.4647	
	Interest Over Time	0.39, 0.5319	1042.19	0.0037		0.63, 0.5319
	Avg Temp/Interest Over Time	0.72, 0.4898	1041.97	**0.0135**	-1.02, 0.3093	0.95, 0.3452

Figure 11: Ratios of Statistically significant models, 2004-2015 vs 2008-2015

Ratio of Models Statistical Significance for Onset Cases		
	2004-2015	2007-2015
Avg Temp	31/34	30/34
Google Trends	14/34	19/34
Both	5/34	8/34

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