Incidence of Solar Retinopathy and Photokeratitis in Private Retina Clinics Post-2017 and -2024 US Solar Eclipses

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Background

- The 2017 and 2024 solar eclipses across the US received significant attention, resulting in a surge in direct solar observation.
- US health authorities extensively communicated the danger of observing these eclipses without adequate protection,[1] including solar retinopathy and photokeratitis:
  - Solar retinopathy is a retinal condition caused by direct exposure to intense sunlight without protection:
    - This exposure may damage the retina, which affects vision and can result in vision loss.
  - Photokeratitis is an acute inflammatory response of the cornea to excessive ultraviolet (UV) exposure that can cause temporary vision loss.

Objectives

- To evaluate the incidence of solar retinopathy and photokeratitis, respectively, following the 2017 and 2024 solar eclipses.
- To identify demographic and geographic patterns associated with these ocular conditions.

Methods

- A retrospective cohort study based on data from the Vestrum Health Database from January 1, 2015 to September 30, 2024 was conducted.
- The database consists of de-identified electronic health records (EHRs) from a geographically diverse panel of 370 US-based private retina specialists. It includes >2.4 million US patients and >18 million patient visits and contains data received in structured fields (e.g., diagnoses, procedures, medications, visual acuity), and data derived from natural language processing (NLP) algorithms that query unstructured text fields, such as medical history, exam findings and impressions, and details on illnesses/diagnoses not found in the International Classification of Diseases code description.
- All patients with valid demographic characteristics, and with no prior diagnosis of solar retinopathy or photokeratitis were assessed until their last visit within the data collection period. The first visit that resulted in a diagnosis of solar retinopathy or photokeratitis was identified and attributed to each post-eclipse period if it occurred during the 2-month periods following the 2017 and 2024 solar eclipses, respectively. Patients were described at the incident visit inside the post-eclipse period, and no follow-up was included.
- Patients' demographic and clinical characteristics were described using summary statistics.
- Incidence rates of solar retinopathy and photokeratitis were calculated per 1,000,000 eyes assessed during the 2-month post-eclipse periods (2017, 2024)
- Geographical trends in disease incidence were analyzed using special analysis and time series modeling (autoregressive integrated moving average). Incident rate ratios (IRR) were calculated against expected incidence rates for each state and time period based on the 3 years of data prior to each eclipse, respectively.

Results

- A total of two million patients were seen by specialists who contribute to the Vestrum Health Database during the combined 4-month post-eclipse exposure period, of whom 147 and two had evidence of solar retinopathy and photokeratitis, respectively:
  - The incidence of solar retinopathy or photokeratitis was fourfold more common during both post-eclipse periods of 2017 (IRR = 4.1; 95% CI: 2.4–6.9, $p<0.001$) and 2024 (IRR = 3.9; 95% CI: 2.1–7.0, $p<0.001$)
- The mean (SD) age of patients who experienced one of these diseases was 41.4 (18.9) years, and most (55.7%) were male (Table 1):
  - The mean (SD) time to diagnosis following the eclipse was 19.0 (17.7) days in 2017 and 20.0 (17.6) days in 2024; approximately 71% presented within 30 days of the eclipses in 2017 and 2024.
  - Sixty percent of patients presented with bilateral disease.
- Males (56% vs. 49%) and patients aged 18–39 years (40% vs. 30%) were significantly more likely to present with the disease as compared with the US population[2] ($p<0.001$) (Table 1).

Table 1. Characteristics at Presentation of Patients Diagnosed with Solar Retinopathy or Photokeratitis During Post-eclipse Periods, by Period

| Characteristics	Overall	2017	2024
Patients	149	69	80
Bilateral Incidence Rate	60%	60%	60%
Age (mean), years	41.4	40.7	42.0
<18	12%	15%	10%
18–39	40%	38%	43%
40–59	27%	26%	28%
60+	21%	22%	20%
Male	56%	61%	53%
Female	44%	39%	47%
Time to Diagnosis following Eclipse (mean), days	20	19	20
<10 days	43%	45%	41%
10–19 days	13%	12%	15%
20–29 days	15%	15%	15%
≥30 days	29%	28%	29%
Vision at Diagnosis	20/32	20/32	20/32

Results (cont.)

Figure 1. Incidence Rate of Solar Retinopathy and Photokeratitis over Time in the US
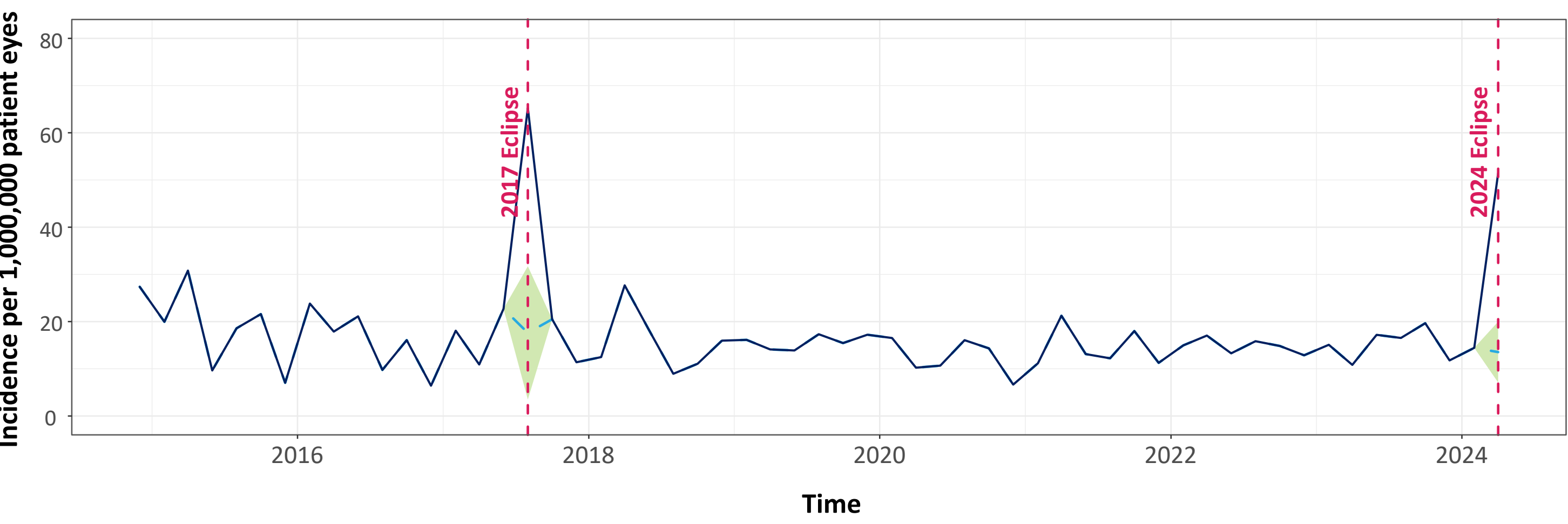
*Green area represents the 95% CI for forecasted incidence rate during each eclipse period

- Solar retinopathy and photokeratitis were more prevalent during the post-eclipse periods compared with all other timepoints observed (Figure 1).

Figure 2. Incidence Rate Ratio of Solar Retinopathy and Photokeratitis in 2017*
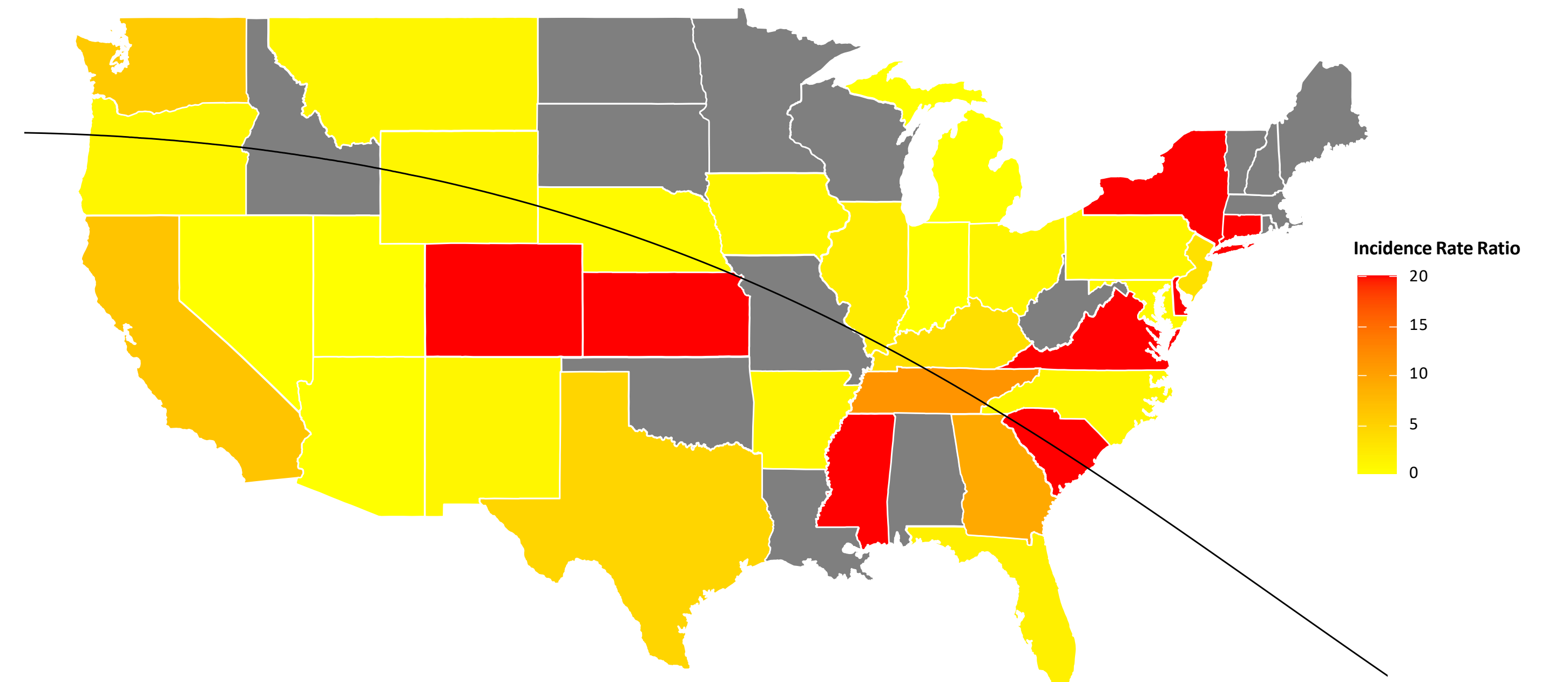
*State level IRR of observed vs. expected incidence rates during the two months post August 2017 solar eclipse
Note: Gray area represents states without adequate data. Black line represents the total eclipse path in 2017

Figure 3. Incidence Rate Ratio of Solar Retinopathy and Photokeratitis in 2024*
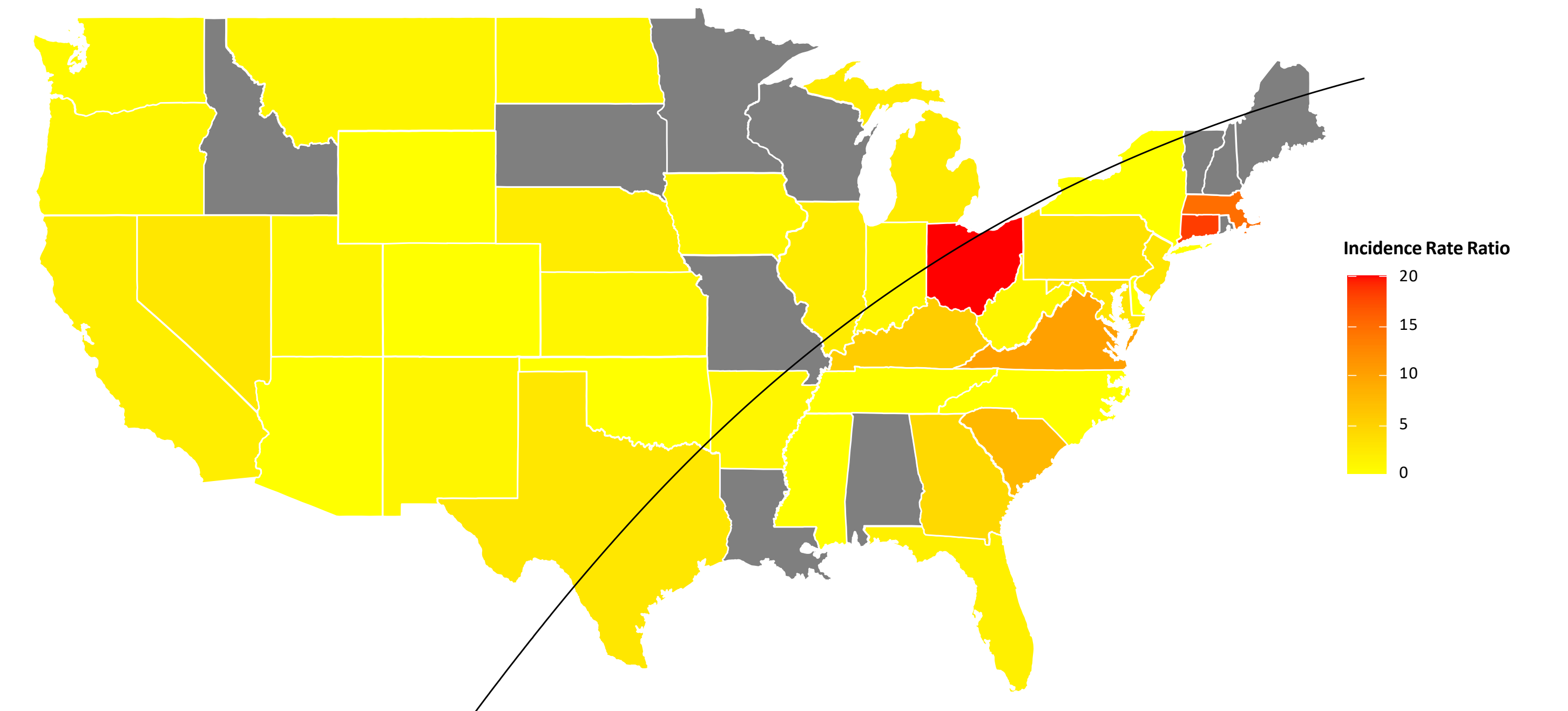
* State level IRR of observed vs. expected incidence rates during the two months post August 2024 solar eclipse
Note: Gray area represents states without adequate data. Black line represents the total eclipse path in 2024

- State-level IRRs highlight the locations reporting a higher incidence of disease relative to the forecasted incidence for 2017 (Figure 2) and 2024 (Figure 3).

Limitations

As patients with mild symptoms may not seek retina specialist care, findings may underestimate the impact of these eclipses on retina health (i.e., "true" incidence may be higher than reported).

Conclusions

- Despite extensive promotional campaigns across the US, our findings suggest that solar eclipses continued to be a risk factor for solar retinopathy and photokeratitis.
- Compared with expected rates of solar retinopathy and photokeratitis, specific geographic areas, particularly regions near the total eclipse line, presented with significantly higher rates of cases in both 2017 and 2024.
- While there appears to be a reduction in the overall incidence from 2024 compared with 2017, it was nominal and not statistically significant ($p=0.07$).
- Many outside factors, such as time of year each eclipse occurred, changes in promotion of risk, or better protective equipment, may have contributed to the nominally lower rates in solar retinopathy and photokeratitis observed in 2024 (vs 2017); more investigation is needed to observe the true impact of solar eclipses and to better understand effective means to prevent retinal damage associated with them.

References

1. NASA. Eclipse Viewing Safety. 2024.
2. US Census Bureau. Current Population Reports. 2023.