

Running head: MASS SHOOTINGS

On United States Mass Shootings

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Author Note

The data that supports the findings of this study are available from the corresponding author upon reasonable request. The author has no conflict of interest to declare.

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Abstract

The severity of the effects on organisms, especially human males, of histamine and serotonin biochemical interactions - and their subsequent behaviors - has been vastly underestimated in the scientific community. Humans, like all life, are sensitive to their environment. Mentally ill or unstable individuals can be triggered into impulsive and violent activities from spikes in serum serotonin. Human serum histamine level is directly proportional to environmental allergen or pollen levels, but serum serotonin level is inversely proportional to serum histamine levels with human males having 52% more serotonin than females. Data show an association between the dates of violent acts, especially male single shooter mass shootings in the United States, and the dates of dramatic decreases in pollen levels thus indicating pollen and serum histamine level drops as a possible precursor or triggering relationship. This knowledge can be used as a potential predictor for law enforcement and medical agencies for a given city or region. Mental health professionals would be advised to lower serotonin boosting meds and even supplement antihistamine and sedative medications to male patients in the timeframes of March through June, for spring tree pollens especially juniper tree pollen, and from September through November, for fall ragweed weed pollen.

KEY WORDS: mass shootings, histamine, serotonin, pollen, pollen.com, allergies

Introduction

Humans, like all life, are sensitive to their environment. Mentally ill or mentally unstable individuals can be triggered into impulsive and violent activities from spikes in serum serotonin (1). Human serum histamine level is directly proportional to environmental allergen levels producing the obvious and dreaded seasonal allergic reaction symptoms. But serum serotonin level, or the control of the level, is inversely proportional to serum histamine levels (2) (3) (4). It is critical to note that male humans have 52% more serotonin than females (5). Note too that mast cells in the human body emit serotonin, a mood-modifying molecule, per Science magazine (6). The European Journal of Neuroscience notes that “mast cells are a source of serotonin. We conclude that mast cells contribute to behavioral and physiological functions of the hippocampus. It is known that mast cells can synthesize and store serotonin. The hippocampus is important in the regulation of anxiety and depressive behaviors” (7).

Also, as noted in the journal Nature:

Because of mast cell involvement in these clinical syndromes... there has been great interest in the pharmacological modulation of histamine release from mast cells. Serotonin is also stored in mast cell granules. Because histamine and serotonin may have divergent functions in delayed hypersensitivity, we hypothesized that these amines could undergo differential release (8).

An emergency medicine case report by Sara Assadi et al. notes that “histamine receptors, for example H3 receptors, when stimulated, inhibit the release of intracerebral serotonin” (9). Research by Catherine Young and team note that “histamine can inhibit the reuptake of serotonin by brain synapses” (10). Eberhard Schlicker and team in their 1988 research note:

Rat brain cortex slices preincubated with 3H-serotonin were superfused with physiological salt solution (containing citalopram, an inhibitor of serotonin uptake) and the effect of histamine on the electrically (3 Hz) evoked 3H overflow was studied. Histamine decreased the evoked overflow in a concentration-dependent manner. The results suggest that histamine inhibits serotonin release in the rat brain cortex via histamine H3 receptors (11).

Research has also noted histamine associations to human ailments like anxiety and schizophrenia. Research in 2017 by Ruihua Hou and team found “evidence that Generalized Anxiety Disorder (GAD) is associated with an imbalance between interferon (IFN- γ), interleukin (IL-10), and tumor necrosis factor (TNF- α), which is released by mast cells” and that “patients with GAD had high levels of pro-inflammatory IFN- γ and TNF- α , but low levels of the anti-inflammatory IL-10, compared to healthy control subjects” leading them to “believe that an impairment of the tryptophan degrading enzyme leads to degradation of serotonin in patients with GAD” (12). Katarina Meskanen et al in 2013 research at the University of Helsinki found that the antihistamine famotidine (Pepcid) decreases schizophrenia symptoms:

[T]he histamine system in the brain could have a central role in the treatment of psychosis, and could lead to the development of a new class of psychosis medications. Famotidine works by blocking the histamine H2 receptor. There are important neurons in the brain that use histamine as their primary signaling substance. These neurons have an important role as regulators of other signaling substances. [T]he histamine system in the brain offers a novel approach to treating psychosis. This should lead to increased efforts by the pharmaceutical industry to develop medications based on this histamine-based mechanism (13).

Jean-Michel Arrang et al. also noted in their 2007 research that “the evidence remains therefore largely indirect, but supports a role of histamine neurons in schizophrenia” (14).

Mass Shootings

Data from public online webpages, like pollen.com and weather.com, of pollen levels in given cities or zip codes, when compared to the dates of gun violence, “mass shootings,” by mentally ill human males, appears to show a clear association between the date of violent acts and the dates of dramatic decreases in environmental pollen allergen levels (especially when the allergen or pollen level decreases overnight to a level of zero) indicating a possible precursor or triggering relationship. This knowledge could be used as a potential predictor for law enforcement and medical agencies with modern technology that can track near real-time levels per a given city or zip code. Mental health professionals would be advised to lower serotonin boosting meds and even supplement antihistamine and sedative medications to male patients in the timeframes of March through June, for spring tree pollens especially juniper tree pollen, and from September through November, for fall ragweed weed pollen. This treatment can even be tailored closer depending on the latitude versus the time of year using pollen tracking applications.

A scientific motto, often demonstrated true, is that *biology drives psychology*. The advent of near real-time tracking of allergen levels in modern cities has led to a possible predictive system or model from the known human serum biochemistry of histamine and serotonin interactions versus the observed year-over-year acts of violence and mass shootings from mentally unstable male individuals. This model can be useful, if not critical, for law enforcement, clinical psychologists, and public safety. Having a heightened level of risk and increased social monitoring during the times of the year in each city or region when allergen or

pollen levels increase, and thus can have major drops or fluctuations, and especially during the month(s) after the pollen season as the allergens drop down to zero, can save lives. Law enforcement, emergency services (911) staff, medical staff, as well as the male mental health patients themselves, knowing these factors a priori, can take proactive and preventive actions and be in a heightened state of awareness and literally track levels on simple and public websites like <https://weather.com/> and www.pollen.com. “Normal individuals” may even be able to observe, track, or understand simple impulsive behaviors from similar, albeit manageable, increases in blood serum serotonin levels that lead to excess confidence and risk taking from the biochemistry of the associated crash in airborne allergens of pollen that, thus, lowers serum histamine levels. Those behaviors can include individuals getting anxious or angry, gambling, buying stocks, spending more, increased sexual activity or alcohol use, or even spikes in suicide (15).

There is a remarkable “pattern match” where mentally unstable individuals almost always (especially relative to those that had already been planning or staging an act of violence, terror, or gun violence) will be triggered, i.e., they “cannot resist the impulse,” to act during the surge in blood (brain) serotonin levels due to a sudden and large drop in environmental allergen levels, that crashes serum histamine, causing the aforementioned spike in blood (brain) serotonin (Figure 1). The key scenarios for the model occur during the final drop-off point to zero pollen of annual spring tree pollen (especially juniper) and fall weed pollen (especially ragweed) and from large drops (a sharp drop in pollen level defined as a drop crossing over at least two or three horizontal levels in the pollen.com history graph e.g., from *Medium* to *Low-Medium* to *Low*) or these same drops followed by a spike of pollen (e.g., a one day long rainstorm in the

middle of pollen season), where we find the perfectly matched timing of violent events - especially single male shooter gun violence or “mass shootings.”

Methods

A sample of fifty-five (fifteen in fall months and forty in spring months) high-profile mass shootings, each involving a single male shooter, between fall 2017 and spring 2023 was created and analyzed (Figure 2). The label “high-profile” being defined as a mass shooting example that was a headline story on the CNN news channel’s webpage at www.cnn.com. A histogram of all fifty-five of the mass shootings from our sample (counts per month) shows a correlation with the months of high pollen, with a larger number of months being spring months, matching the much larger number of spring pollen months versus fall pollen months (Figure 3). The distribution percentages of mass shooting events between spring and fall are very close to the distribution of heavy pollen months for each season. Note how five of the seven heavy pollen months are in spring and that $5/7 = 0.714$. We see in our histogram forty of the total fifty-five mass shooting events in spring, $40/55 = 0.727$. Fall has two of seven months with heavy pollen, $2/7 = 0.285$ and fall has fifteen of fifty-five mass shooting events, $15/55 = 0.272$. The skew where the spring season has more months with major pollen than fall or summer can be seen in graphs of each pollen season on the pollen.com smartphone application called Allergy Plus where the spring season has high pollen in the five months of February, March, April, May, and June, the summer season with only grass pollen has negligible pollen levels and density and thus no real effects, and the fall pollen season has high pollen in the months of August and September (Figure 4). The extremely large pollen events each year in the continental United States are the early spring juniper tree pollen bursts in February or March and the fall ragweed burst that lasts from the end of August through all of September. After juniper tree pollen in the

spring, additional trees have significant, but less massive, pollen events. They include in order: willow, elm, maple, birch, alder, poplar, beech, sycamore, ash, oak, hickory, and walnut trees. Summer and early fall have some grasses and weeds that have very minor pollen windows, but these are negligible by comparison and include the grasses: timothy, orchard, and bermuda grass and the weeds sorrel, plantain, lambsquarters, pigweed, and sage (Figure 5).

Another correlation is seen where mass shootings occur just *after* the peak pollen months i.e., as pollen decreases, and serum serotonin thus increases especially *after* the two largest pollen events of spring juniper tree pollen (mid-February to mid-March) and fall ragweed weed pollen (August to September) (Figure 6).

In essence, the continental United States has a massive pollen burst every February or March from juniper tree pollen followed by a large spike of mass shootings for a month at the end of February and especially in March by male humans allergic to juniper tree pollen as the histamine declines and serum serotonin spikes in these individuals literally pushing them mentally “over the edge.” The next four months of April, May, June, and July then continue to have mass shootings from male humans the month *after* each of the subsequent twelve tree pollen events that occur in March, April, May, and June. In the fall, when ragweed weed pollen declines in October and November and the first “winter frost” temperatures approach, there is then the other large spike in male mass shootings that occurs starting in northern cities and moving down the latitudes (Figure 7). Note the lack of any mass shootings in our sample in the months of September (entire month has ragweed) and December and January (cold winter months with zero pollen). The near real-time www.pollen.com website is a near perfect proxy to match mass shootings to these changes in pollen and histamine levels for a given zip code of the location of a mass shooting event.

Mass shooting events that perfectly fit this model, where a dramatic drop in pollen coincides exactly with a mass shooting event, include the March 17, 2021, Acworth (Atlanta) Georgia Asian spa shooting (Figure 8), the March 22, 2021, Boulder Colorado King Store shooting (Figure 9), the October 25, 2021, Boise Idaho mall shooting, (Figure 10), the May 24, 2022, Robb Elementary School mass shooting in Uvalde Texas (Figure 11), and the August 28, 2023, University of North Carolina Chapel Hill graduate student shooting (Figure 12).

Mass shooting events that perfectly fit the model where a pollen season is over and pollen levels decline to zero include five events between November 11, 2022, and November 22, 2022, all occurring as fall ragweed weed pollen decreases to zero in each city (Figure 13).

Large public events during, and especially after, fall ragweed pollen and spring tree pollen windows for the end-of-season pollen level decline, can be monitored with increased awareness noting that airborne pollen levels will peak and decline following temperature drops and increases i.e., as cold winter temperatures approach in the fall, pollen levels will drop especially from frost, and as hot summer temperatures approach in the spring after the tree pollen peak, usually in March. The pollen levels rise and fall each year moving from North to South in the fall and from South to North in the spring i.e., moving down and up the latitudes of the continental United States.

Discussion

One can speculate that higher levels of pollen in the United States than the rest of the world, especially in the spring, and the increase in the number of frost-free days (possibly from global warming via climate change) is a possible cause of higher gun violence in the United States. Note that the near zero level of mass shootings in Canada, thus, also fits this model as

cities in Canada are too far north to have pollen seasons of any significant length and likely it is that fact, and not legislative policies, which is the cause of the difference.

There are limitations to this hypothesis. The hypothesis does not claim to explain all mass shootings. The claim is that there is a large amount of circumstantial evidence that indicates many mass shootings, especially those done by mentally ill male individuals in the United States, appear to correlate with serum serotonin spikes from pollen and thus serum histamine drops each spring and fall. Universities or laboratories with formal testing facilities might undertake human experiments where: a control group with no allergies, patients with known allergies, and mentally ill patients with and without specific allergies, are all tested with allergy shots of specific allergens (ragweed or juniper pollen as the best examples) and then observed and tested both subjectively, for impulsivity behaviors, and with blood tests to track the exact timing and degree of serum serotonin increase as the allergic response serum histamine spikes and then subsides over the 1-2 day period after the allergy shot. Crime Prevention centers, universities, or government departments with large data sets would be advised when performing formal regression analysis exercises against this hypothesis to consider two key points, 1) to not ignore any survivorship bias or omission bias as a key observation is that so many months of the year have zero mass shootings and that must be take into account in any formal statistical analysis, and 2) that many data sets on mass shootings go beyond the scope of this hypothesis and include any gun related incident where four or more individuals were injured which can include burglaries and drug or gang related violence. The hypothesis has known limitations of lacking comparative data versus other countries. There does exist the predicted decline in mass shootings in Canada where pollen seasons are very short due to the colder climate in higher latitudes. Detailed and near real-time tools like pollen.com (tracks down to a

given city zip code) were not found for European or Asian countries that also have tree and weed season pollen. The prevalence of guns (per capita count) in the United States is also a factor that must be considered when comparing against other countries.

Additional Evidence

If one supports the hypothesis that drops in pollen level can affect human behavior, then there should be additional evidence to support the claim. Are there other data sources that match the claims of pollen levels, indirectly via poor sleep (from lower serotonin and allergic breathing issues) and directly, via serotonin changes, leading to impulsivity and aggression, as pollen drops? Research does show additional data that support the claim.

An analysis by researchers for the website *visualcapitalist.com* showed a list of states, in the United States in 2025 ranked by median household bank balance, “where Americans have the most cash” (16). The site’s posted image notes that the “cost of living, income gaps, spending habits, & investment patterns help explain differences in cash balances across the country” (Figure 14). But if our hypothesis proposes that states with a higher pollen level also have higher impulsivity, then these same higher pollen states should have residents with less cash in their bank accounts, i.e. impulsivity is directly associated with excess spending. This is exactly what the data sources show. As seen on a 2025 webpage from *vividmaps.com* (18 as cited in 17), eleven of the twelve states with residents with the lowest cash balance, are states with the highest pollen levels : Mississippi, Alabama, Oklahoma, New Mexico, Georgia, Kentucky, Louisiana, Missouri, Tennessee, Arkansas, and Texas (Figure 15). The top five states with residents with the highest bank account balances, are all states at a higher latitude and with zero to very low pollen levels including, in order, Hawaii, New Jersey, Washington, Massachusetts, and Minnesota (Figure 15).

A report by *brilliantmaps.com* from CDC data also supports the hypothesis (19). Their graphic map of states and counties where Americans get the worst sleep, should show worse sleep at higher latitudes, due to less sunlight and vitamin D impacting circadian rhythms, but it does not (20). The pattern of states where residents get the worst sleep is a closer match to states in the southeast United States with higher levels of pollen (Figure 16).

A graphical map from researchers for the website *landgeist.com* (22 as cited in 21) shows the countries in North America and the states in the United States with the most gun deaths in 2024. Again we see a pattern that matches the pattern of states with high pollen levels and the number of gun deaths decreases significantly as one moves higher in latitude in the United States and into Canada (Figure 17).

Another significant observation, that supports the association between environment and thus pollen with United States mass shootings, is the occurrence of all mass shootings in this paper since 2017 with the years of the La Niña weather or climate cycle (2017, 2018, 2020, 2021, 2022, 2023) and, as of spring 2024, the association of all years with zero mass shootings (2019, and spring 2024) with El Niño years. Ellen Druffel et al. note that:

La Niña events have been observed for hundreds of years, and occurred on a regular basis during the early parts of both the 17th and 19th centuries. Since the start of the 20th century, La Niña events have occurred during the following years: 1903–04, 1906–07, 1909–11, 1916–18, 1924–25, 1928–30, 1938–39, 1942–43, 1949–51, 1954–57, 1964–65, 1970–72, 1973–76, 1983–85, 1988–89, 1995–96, 1998–2001, 2005–06, 2007–08, 2008–09, 2010–12, 2016, 2017–18, 2020–23 (16) (17).

As noted in Yale Climate Connections, “Since 2000, El Niño events have been observed in 2002–03, 2004–05, 2006–07, 2009–10, 2014–16, 2018–19, and 2023–24” (17)(18)(19)(20)(21)(22)(23)(24).

Chris Kimble describes the “atmospheric response” of El Niño (2019 and 2024) on the National Weather Service website in 2024:

During El Niño the southern jet stream strengthens especially across the eastern Pacific Ocean. This allows more moisture to be transported onshore in the Southwestern United States and generally more storminess across the southern part of the country in general. The northern polar jet stream is shifted northward across the United States, reducing the number of cold outbreaks across the central United States (25).

Mass shootings occurred in the spring of the La Niña year 2023 in Nashville Tennessee on March 27 (26) and in Louisville Kentucky on April 10 (27) and April (28). Marcus Bagwell, a reporter in Nashville Tennessee noted in 2024:

La Niña has to do with the waters in the Equatorial Pacific Ocean. When these waters are colder than normal, La Niña is in effect, impacting our weather in the United States. The La Niña pattern usually brings Middle Tennessee and Southern Kentucky warmer temperatures and greater Gulf moisture. If the pattern is strong, it can create a greater clash of warmer and colder air, possibly increasing the potential of major severe weather (29).

Knolmajer et al., in their research on European ragweed note that "summer periods between 1999 and 2007 were hot and dry, which led to a reduced pollen concentration" (30). They also note how climate change could be driving higher levels of fall ragweed pollen as “due to the additive effect of a higher temperature and CO2 level, the vegetative biomass production will

increase, and this fact will also contribute to higher pollen production" (30). Suzanne T.E. Lommen et al., in 2018 research "found that plant size is the most important determinant in variation of per-capita seed and pollen production ...bigger plants in warm and wet conditions" (31).

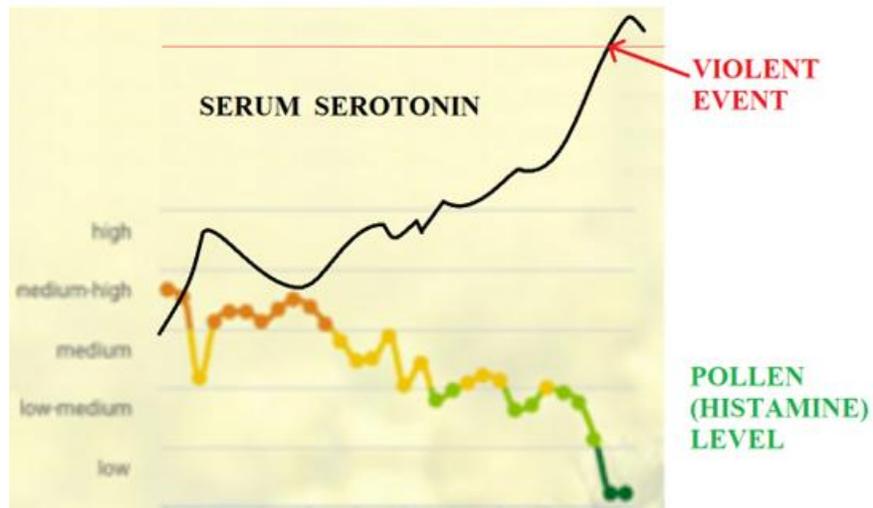
Conclusion

The ideas and knowledge in this hypothesis can be used as a potential prediction tool - for law enforcement, mental health, and medical agencies - that uses modern technology and data sources that can track near real-time levels of pollen per a given city or zip code. Mental health professionals would be advised to lower serotonin boosting meds and even supplement antihistamine and sedative medications to male patients in the timeframes of March through June, for spring tree pollens especially juniper tree pollen, and from September through November, for fall ragweed weed pollen.

Figures

Figure 1.

The inverse relationship between serum histamine and serum serotonin in the human body leads to significant behavioral effects - especially in human males - as allergens rise and fall each season.



Source: www.pollen.com

Figure 2.

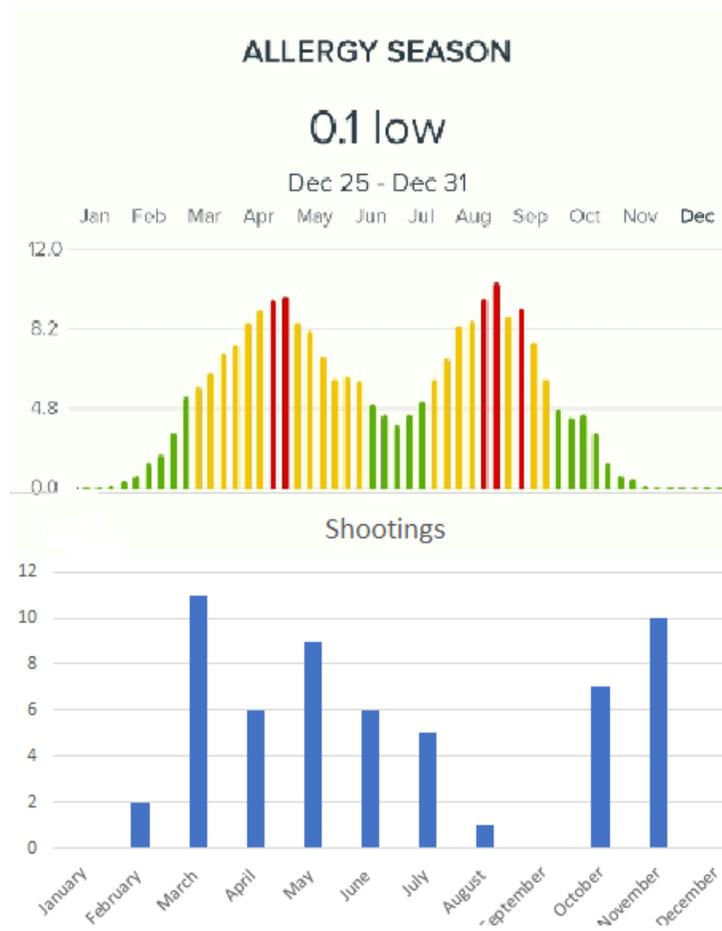
The analyzed sample includes 55 (15 in fall and 40 in spring) high-profile single male shooter mass shootings between fall 2017 and spring 2023. High-profile being defined as being a headline story on the CNN news channel's webpage at www.cnn.com.

2/14/18 - Parkland, FL	10/1/17 - Las Vegas, NV
2/19/23 - New Orleans, LA	10/7/21 - Arlington, TX
3/16/21 - Acworth, GA	10/10/21 - St. Paul, MN
3/19/22 - Houston, TX	10/21/21 - Superior, NE
3/19/22 - Fayetteville, NC	10/25/21 - Boise, ID
3/19/22 - Norfolk, VA	10/27/18 - Pittsburgh, PA
3/19/22 - New Iberia, LA	10/30/21 - Texarkana, TX
3/19/22 - Dumas, ARK	11/5/17 - Southerland Springs, TX
3/19/22 - Madison Heights, VA	11/13/22 - Moscow, ID
3/19/22 - Dallas, TX	11/17/22 - Miami, FL
3/19/22 - Austin, TX	11/19/22 - Miami, FL
3/22/21 - Boulder, CO	11/19/22 - Colorado Springs, CO
3/27/23 - Nashville, TN	11/13/22 - Charlottesville, VA
4/10/23 - Louisville, KN	11/22/22 - Cheasapeake, VA
4/12/22 - Brooklyn, NY	11/23/22 - Temple Hills, MD
4/15/23 - Louisville, KN	
4/15/23 - Middle Falls, NY	
4/15/23 - Dadeville, AL	
4/29/23 - Davis, CA	
5/1/23 - New York, NY	
5/4/23 - Ocean Springs, MS	
5/4/23 - Columbus, OH	
5/6/23 - Chico, CA	
5/13/22 - Milwaukee, WS	
5/13/22 - Milwaukee, WS	
5/13/22 - Omaha, NE	
5/14/22 - Buffalo, NY	
5/24/22 - Uvalde, TX	
6/6/23 - Richmond, VA	
6/13/23 - Denver, CO	
6/18/23 - St. Louis, MO	
6/18/23 - Willowbrook, IL	
6/24/23 - Saginaw, MI	
6/25/23 - Kansas City, MO	
7/2/23 - Baltimore, MD	
7/3/23 - Philadelphia, PA	
7/3/23 - Indianapolis, IN	
7/4/23 - Shreveport, LA	
7/9/23 - Cleveland, OH	
8/28/23 - Chapel Hill, NC	

Source: www.cnn.com

Figure 3.

A histogram of all 55 mass shootings of our sample (count by month) shows a correlation where there are more mass shootings in spring months and the most pollen months are in the spring. The pollen.com app shows the annual pollen peaks of spring and fall (below top).



Source: pollen.com smartphone app “Allergy Plus.”

Figure 4.

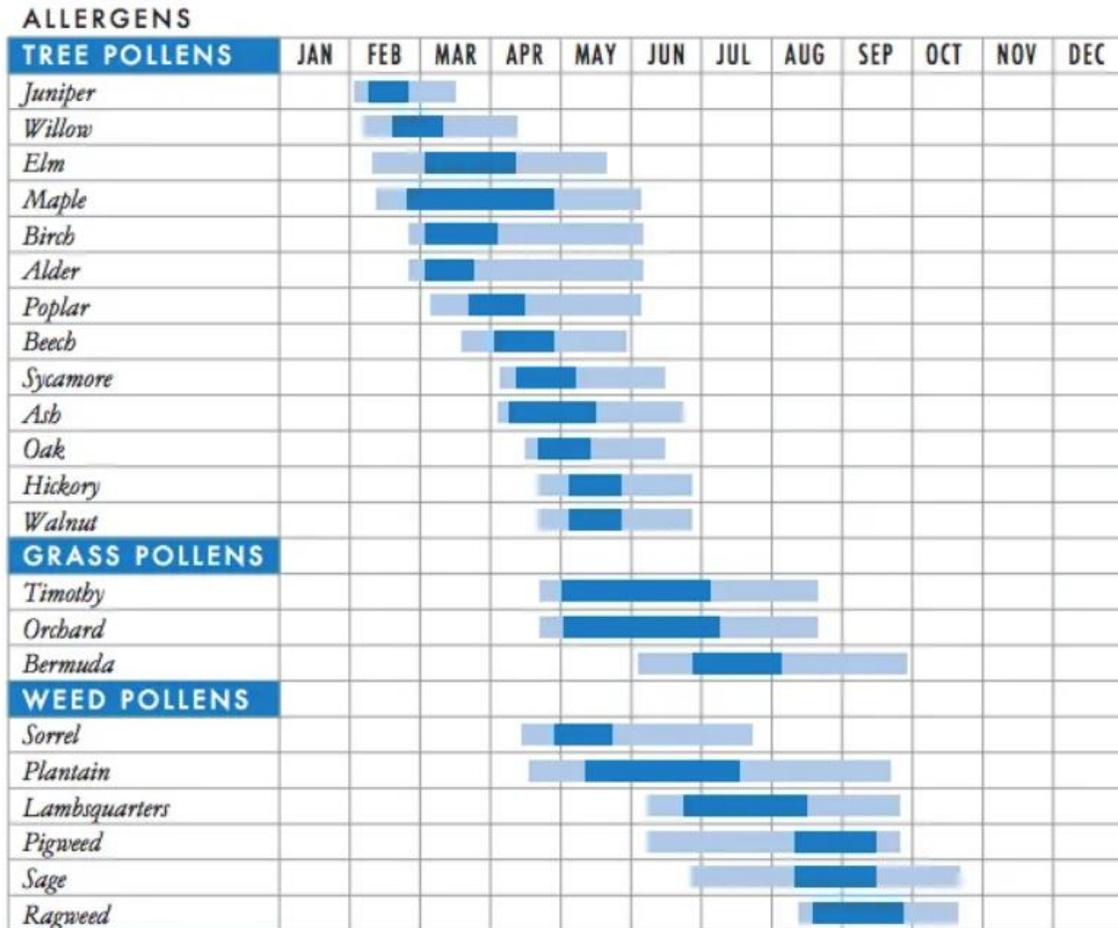
The pollen.com Allergy Plus smartphone application shows the skew of five months of high pollen in the spring and only two months of high pollen in the fall each year.



Source: pollen.com smartphone app “Allergy Plus” retrieved Mar 3, 2023.

Figure 5.

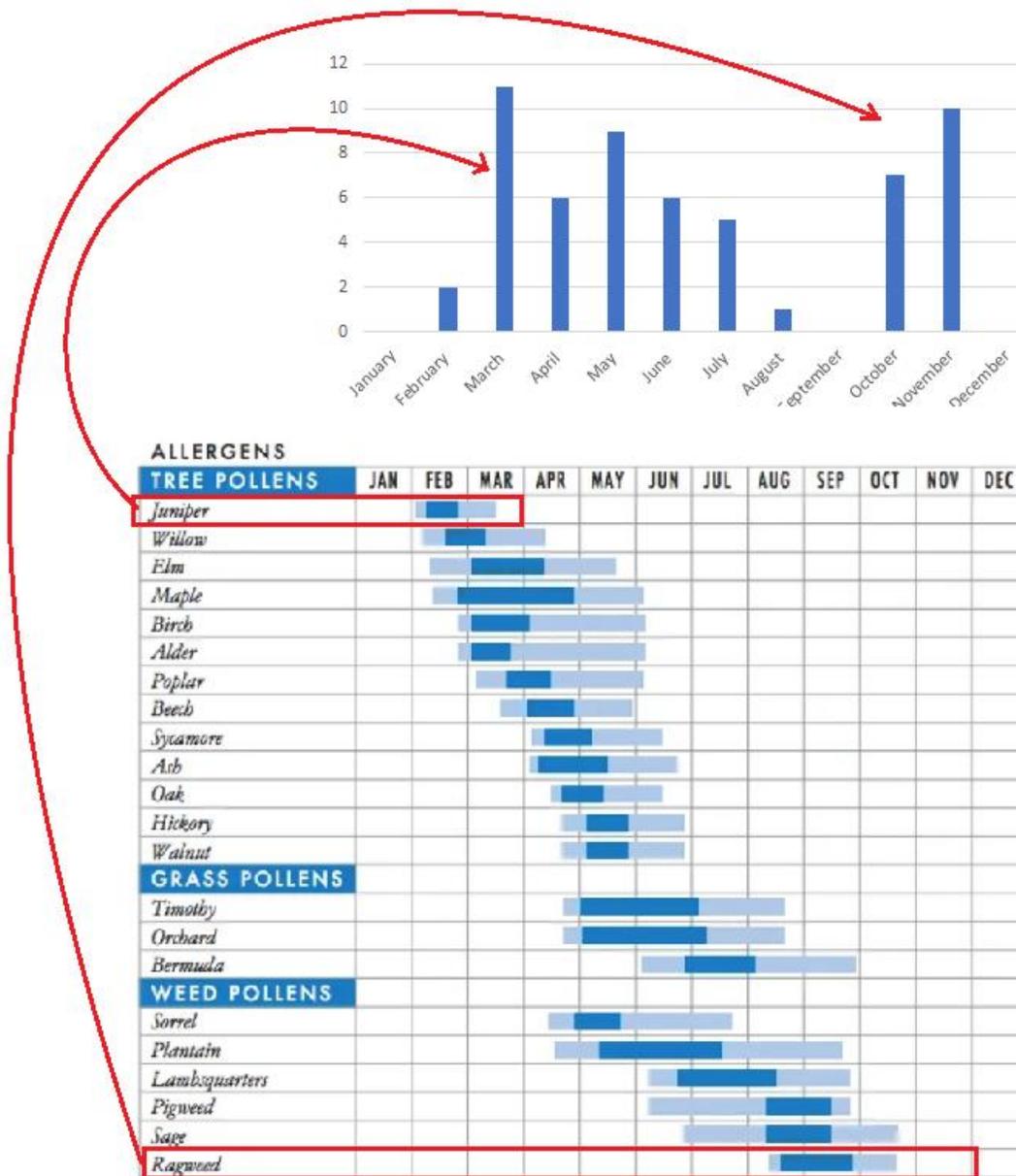
Beyond the two major pollen generating plants of juniper trees in spring and ragweed weeds in the fall, there are additional trees that release significant pollen amounts each spring between March and June.



Source: <https://www.vox.com/22383707/allergies-2021-pollen-allergy-covid-19-climate-change-asthma>

Figure 6.

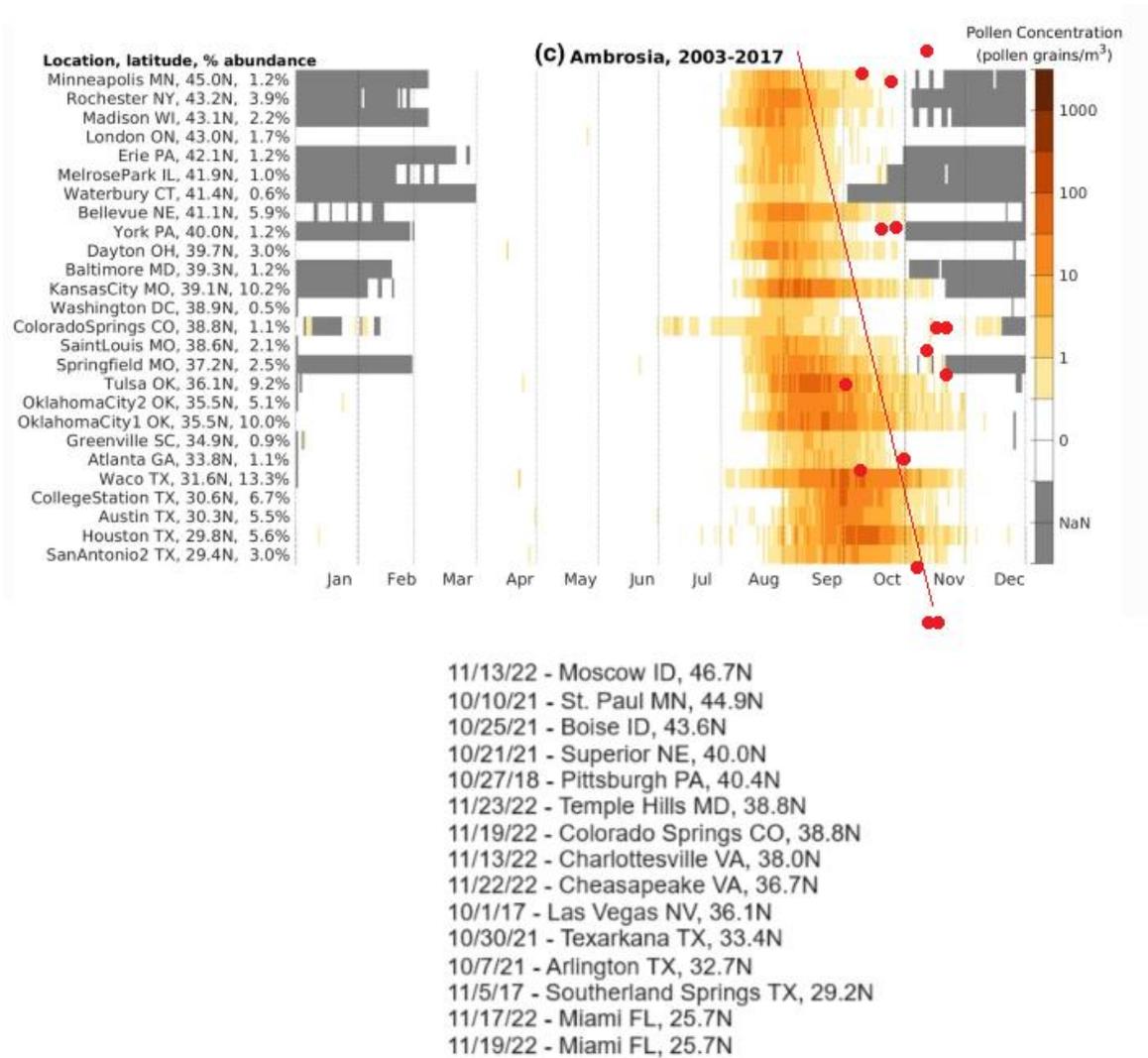
A correlation is also seen where mass shootings occur just after the peak pollen months i.e., as pollen decreases, and serum serotonin thus increases especially “after” the two largest pollen events of spring juniper tree pollen (mid-February to mid-March) and fall ragweed weed pollen (August to September) as noted by the red arrows. Note the lack of any mass shootings in September, December, and January.



Source: <https://www.vox.com/22383707/allergies-2021-pollen-allergy-covid-19-climate-change-asthma> and pollen.com smartphone app “allergy plus” retrieved Mar 3, 2023.

Figure 7.

Each of the fifteen fall mass shootings examples from our sample are shown as red dots on top of a diagram showing U.S. cities and their ragweed levels by month, from north to south. Note how every mass shooting example occurs after the peak ragweed or completely after ragweed season ends for the season. Note too how the end of ragweed season by latitude occurs diagonally as “winter frost” cold temperatures begin in the north and slowly move to southern latitudes.



Source: Figure 5 in Lo, F., Bitz, C.M., Battisti, D.S. et al. Pollen calendars and maps of allergenic pollen in North America. *Aerobiologia* 35, 613–633 (2019).

<https://doi.org/10.1007/s10453-019-09601-2>

Figure 8.

A mass shooting at an Acworth (Atlanta) Georgia Asian spa on March 3, 2021, coincides exactly with a large drop in environmental pollen as seen on www.pollen.com.



Source: <https://www.pollen.com/forecast/historic/pollen/30101> and <https://www.cnn.com/2021/03/18/us/atlanta-spa-shootings-victims/index.html>

Figure 9.

A Boulder, Colorado King Store mass shooting on March 22, 2021, occurs right after a dramatic pollen level decline.



Source: <https://www.pollen.com/forecast/historic/pollen/80301> and <https://www.cnn.com/2021/04/22/us/boulder-shooting-suspect-charges/index.html>

Figure 10.

A mass shooting at a Boise, Idaho mall on October 25, 2021, occurs exactly as the fall ragweed pollen level declines to zero.



Source: www.pollen.com and <https://www.cnn.com/2021/10/25/us/idaho-boise-shooting/index.html>

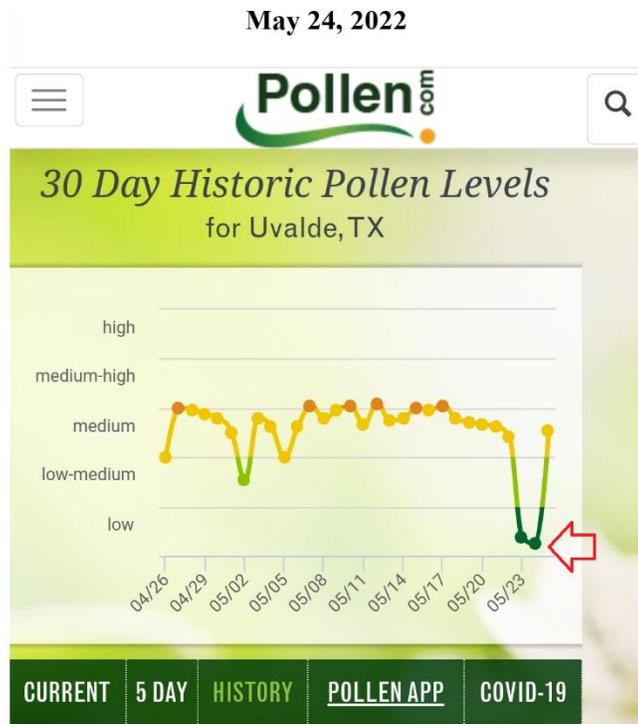
Figure 11.

The www.pollen.com website shows a dramatic multi-level drop in spring pollen level immediately before the day a teenage male gunmen killed 21 at an Uvalde Texas elementary school on May 24, 2022.

(CNN) — An 18-year-old gunman on Tuesday **fatally shot 19 children and two adults** at a Texas elementary school before he was killed by law enforcement officers, officials said.

The shooter -- identified by Texas officials as Salvador Ramos, of Uvalde -- also shot his grandmother before crashing a vehicle near the school, Texas Department of Public Safety Sgt. Erick Estrada said. She is in critical condition, he said.

The gunman is believed to have acted alone, Uvalde Consolidated Independent School District Police Chief Pete Arredondo said.



Source: www.pollen.com and <https://www.cnn.com/2022/05/24/us/ualde-texas-elementary-school-shooting/index.html>

Figure 12.

On Monday August 2, 2023, a male graduate student named Tailei Qi at the University of North Carolina at Chapel Hill shot and killed a faculty member and was arrested for murder. Note the large drop of pollen that occurred the days before the event that created a “serotonin spike.”

University of North Carolina police respond to ‘an armed and dangerous person on or near campus’

By [Devon M. Sayers, CNN](#)

Updated 3:19 PM EDT, Mon August 28, 2023



WTVD

Police work Monday at the University of North Carolina at Chapel Hill.

(CNN) — Police at the University of North Carolina at Chapel Hill are responding to an “armed and dangerous person on or near campus,” according to an alert from the university on Monday.

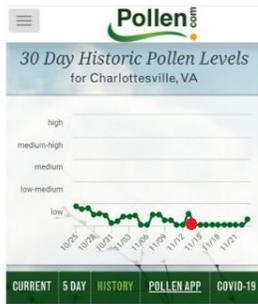
“Remain sheltered in place. This is an ongoing situation. Suspect at large,” the university said in



Source: <https://edition.cnn.com/2023/08/28/us/university-of-north-carolina-shooting/index.html> and www.pollen.com retrieved 30 August 2023.

Figure 13.

Between November 13 and 23 of 2022, four mass shootings and a knife attack occur in the U.S. states of Virginia, Idaho, Colorado, and Maryland at the end of the fall pollen season in the very week that pollen levels as seen on the pollen.com web site “drop to zero.”



At the University of Virginia in Charlottesville – which is about 170 miles west of Chesapeake – a 22-year-old student allegedly **opened fire on fellow students** this month, killing three of them on a bus returning to campus from a field trip to Washington, DC.

Suspect in UVA shooting was on the bus with victims returning from a Washington DC trip, school spokesperson says

By Steve Delaney and Tracy Vanecko, CNN
Updated 7:57 AM EST, March 10, 2022



University of Virginia White House Correspondents' Dinner, Oct. 2021. National Archive. Tony Stone Worldwide/Getty Images for CNN



Idaho students were killed, there are mounting questions in the investigation and few answers

By Travis Calkwell, CNN
Updated Nov 20, 2022

(CNN) - With the investigation into the killings of **four University of Idaho students** in the town of Moscow now entering its second week, authorities say efforts to find the culprit in the attack are ongoing.

"We're trying to expedite everything that might possibly lead to a suspect," Latah County prosecutor Bill Thompson said Saturday.

The four students killed -- Ethan Chapin, 20; Kaylee Goncalves, 21; Xana Kernodle, 20; and Madison Mogen, 21 -- were **discovered by police** last Sunday in an off-campus home. The victims were stabbed to death, according to a county coroner, and the weapon used has yet

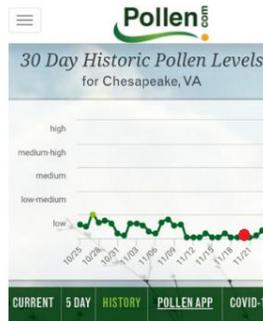


5 people are killed, at least 18 injured in a shooting at a gay nightclub in Colorado Springs

By Andy Rose, CNN
Updated Nov 20, 2022

(CNN) - Five people were killed Saturday night at a gay nightclub in Colorado Springs, Colorado, according to police. Another 18 people were injured in the mass shooting at Club Q.

Authorities received "numerous" 911 calls starting at 11:57 p.m. and responded to the scene, said Colorado Springs Police Lt. Pamela



At least 6 killed in Virginia Walmart shooting

By Aditi Sangal, Adrienne Vogt and Dakin Andone, CNN
Updated 7:37 a.m. ET, November 23, 2022

What we know so far

- At least six people were shot dead Tuesday night inside a Walmart in Chesapeake, Virginia, according to local officials. The shooter is also dead.
- Investigators believe the shooter was an employee or former employee of the store who opened fire on other employees in a break room, a law enforcement source told CNN.
- Chesapeake city officials have scheduled a news conference for 8 a.m. ET.



Police say 4 shot, including 3 teenagers, in Maryland strip mall parking lot

By Amir Vera and Adrienne Winston, CNN
Updated Nov 23, 2022

(CNN) - Four people were shot Wednesday night in the parking lot of a strip mall in Temple Hills, Maryland, including three teenagers, according to police.

Police said the shooting took place at about 8:25 p.m. when a suspect or suspects shot at a group in the 2300 block of Iverson St. in Temple Hills. Three teens and one adult were shot and had what appeared to be non-life threatening injuries, the Prince George's County Police Department **tweeted**.

Source: www.pollen.com and

<https://www.cnn.com/2022/11/14/us/university-of-virginia-shooting-suspect/index.html>

<https://www.cnn.com/2022/11/20/us/colorado-springs-shooting-gay-nightclub/index.html>

<https://www.cnn.com/2022/11/20/us/university-of-idaho-killings-sunday/index.html>

<https://www.cnn.com/2022/11/23/us/temple-hills-maryland-strip-mall-shooting/index.html>

<https://www.cnn.com/2022/11/26/us/chesapeake-virginia-walmart-shooting-saturday/index.html>

Figure 14.

A 2025 post on the website VisualCapitalist.com that ranks states by median household bank balance of their residents. This data is considered as a proxy for impulsivity associated to states with higher pollen having residents with larger spending and thus the lowest ranking on the list.



Figure 15.

A 2025 post on the website Vividmaps.com shows the states in the United States with the worst outdoor environmental allergies. Eleven of the twelve states at the bottom of the list from Figure 14, having residents with the lowest bank account balances, are states with the worst pollen (dark green color) implying an association between high pollen and impulsivity.

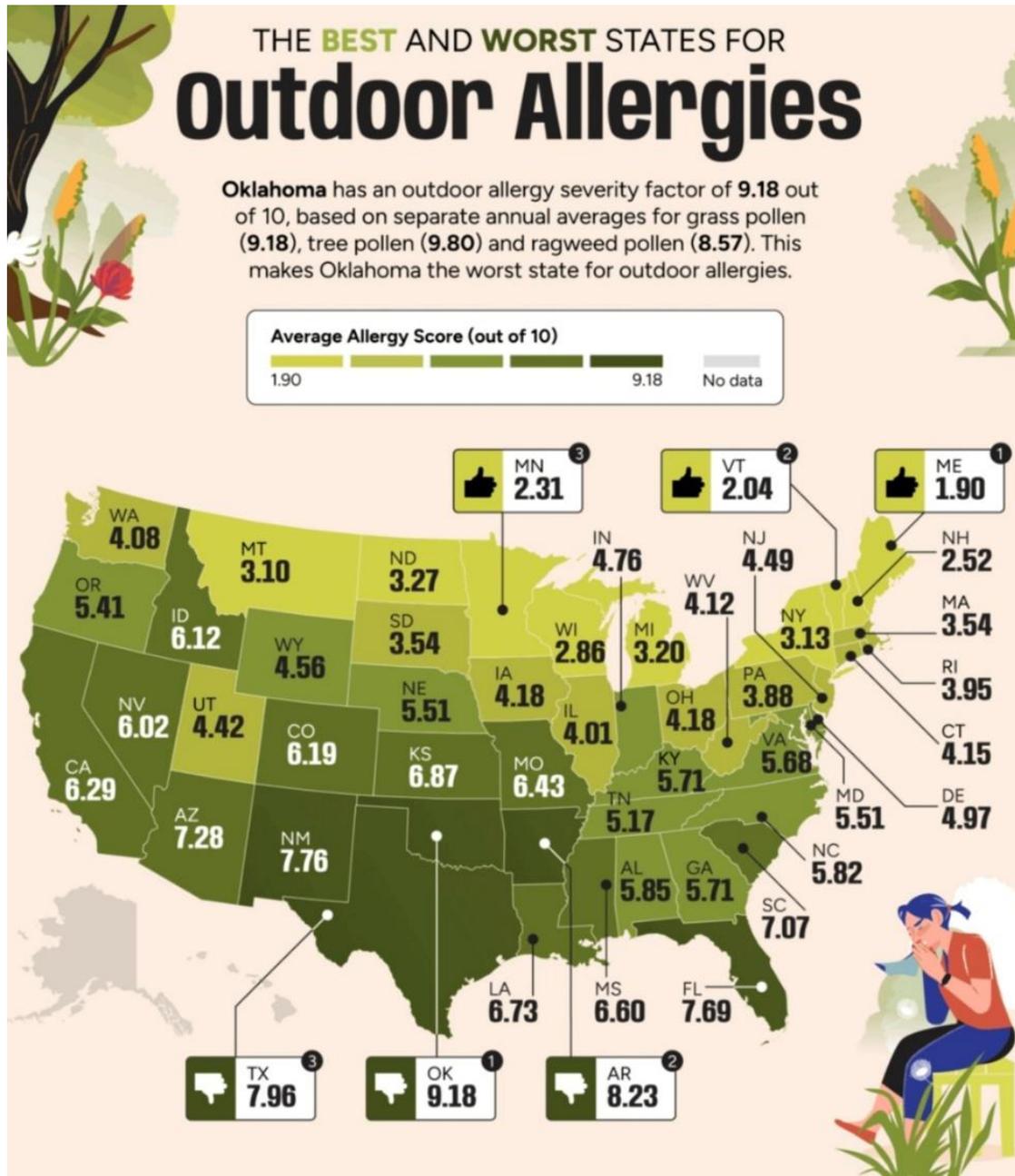


Figure 16.

A 2024 post from the website Brilliantmaps.com displays CDC data of states where residents get the least amount of sleep. Again we see an association between these states and states with the highest pollen level. Poor sleep has been shown to be tied with impulsivity.

Map shows where in the U.S. people don't get enough hours of sleep (less than 7 hours).

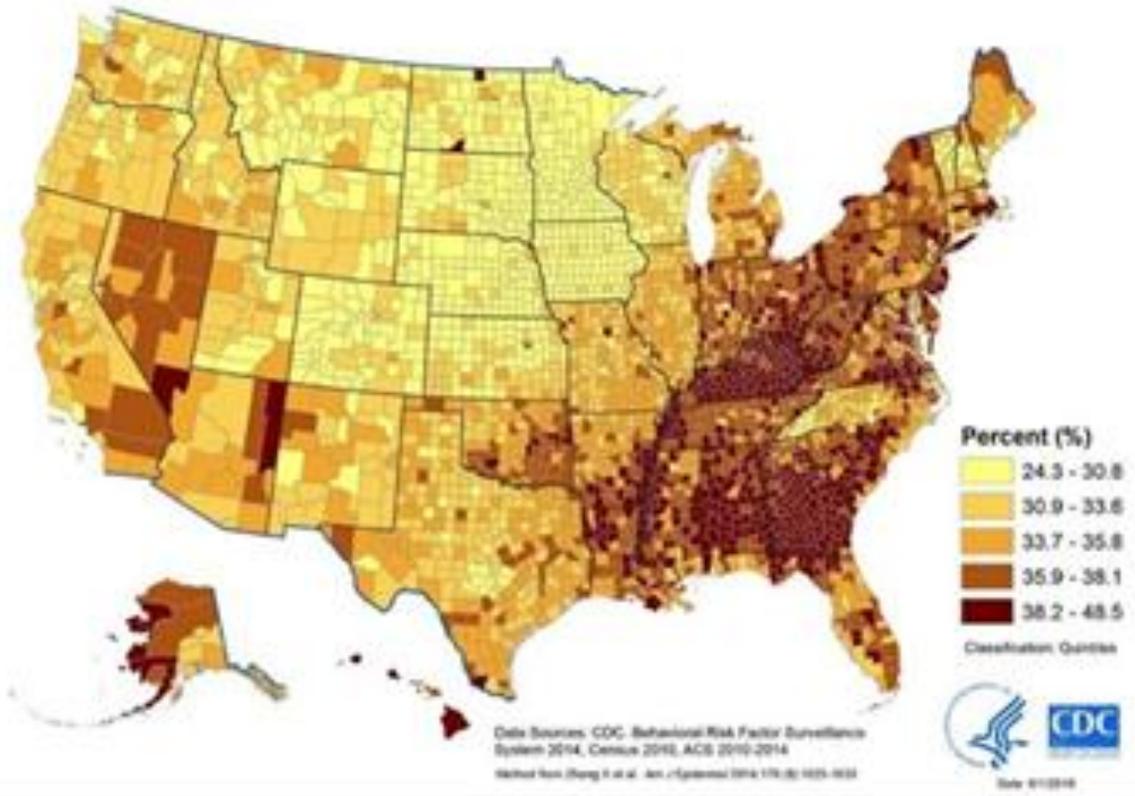


Figure 17.

A 2024 landgeist.com website post shows the states in the United States with the highest number of gun deaths. Again we see an association with the states with the highest level of gun violence death closely matching states with the highest pollen level. States at higher latitudes and up into Canada have the lowest gun violence and have the lowest pollen.



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