



## Review

# A Breath of Fresh Search: The Nose Knows in Evansville, Indiana

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**This research paper explores the intriguing connection between air quality in Evansville, Indiana and Google searches for 'i have a headache'. Leveraging data from the Environmental Protection Agency and Google Trends, our investigation aimed to breathe new life into the relationship between local air quality and public malaise. The correlation coefficient of 0.8191613 and  $p < 0.01$  uncovered from the data for the period spanning 2004 to 2023 suggests a significant association between air quality and the frequency of headache-related Google searches. Our study offers an innovative approach to understanding the impact of air quality on public health and highlights the potential use of online search behavior as a metric for evaluating subjective well-being. It provides valuable insights into the ways in which environmental factors can influence individual experiences. This research not only holds important implications for public health monitoring but also serves as a breath of fresh air for the fields of environmental and health economics, as well as digital health research. This investigation reveals that when it comes to air quality and headaches, the correlation is not just up in the air. Our findings bring a breath of fresh air to the conversation around environmental influence on public health, nurturing a newfound appreciation for the interconnectedness of the air we breathe and the searches we proceed with. Mind you, it's a clear reminder that a breath of fresh air might be just what the doctor ordered for those pesky headaches!**

The idea that air quality might be linked to public health outcomes is not a novel one, but its potential connection to Google search behavior adds a new layer of intrigue to the discussion. As Shakespeare once said, "Something is rotten in the state of Denmark" - and we aim to investigate if that "something" is indeed the air in Evansville, Indiana. By analyzing the frequency of

Google searches for 'i have a headache' alongside air quality data, we seek to shed light on this unexplored intersection of environmental factors and public well-being.

The relationship between air quality and health has been a topic of interest for researchers and policymakers alike. It's time to clear the air and find out if poor air

quality is truly a pain in the head for the residents of Evansville. After all, it wouldn't be the first time air pollution left us all breathless.

#### *Prior research*

In "Smith et al.," the authors find that air quality is a significant environmental factor that can influence public health outcomes. Similarly, "Doe and Jones" investigate the associations between environmental factors and individual health, with a particular focus on the correlation between air quality and physical well-being. These studies highlight the importance of understanding the impact of air quality on public health, shedding light on the potential implications for subjective well-being and overall quality of life in affected populations.

Speaking of air quality and public health, did you hear about the atmospheric composition of Jupiter? It's just gas, gas, gas!

Turning to non-fiction literature, "The Air Pollution Comes from Inner Space" by John Environmentalist and "Breathless in Indianapolis: A Study of Urban Air Quality" by Clean Air Crusader provide valuable insights into the impact of air quality on public health. These works emphasize the need for comprehensive strategies to combat air pollution and its potential effects on individual well-being. While these sources provide important theoretical foundations, it's clear that there's still much to learn about the nuanced relationship between air quality and human health.

If you thought car exhaust was bad for the air, imagine being stuck in a room with a

bunch of comedians - now that's some real air pollution!

Shifting gears to the realm of fiction, "The Mist" by Stephen King and "The Airbender Chronicles" by Elemental Enthusiast present imaginative scenarios that intertwine environmental elements with human experiences. While these books may not offer empirical evidence of the air quality-headache connection, they undoubtedly showcase the captivating role of atmospheric conditions in shaping narratives and character interactions. Despite their fictional nature, these works remind us of the atmospheric influences that underpin our everyday lives, nudging us to ponder the potential impact of air quality on our own well-being.

You might say these books really take the "aerodynamic" approach to storytelling!

In terms of cinematic representations, "The Happening" and "Airplane!" are two films that touch upon the theme of environmental influences on human behavior, albeit in decidedly different tones. While "The Happening" explores a dystopian narrative of nature wreaking havoc on human psychology, "Airplane!" delivers comedic relief through its farcical portrayal of in-flight shenanigans. Despite their disparate approaches, these movies offer a glimpse into the broader cultural fascination with the interplay of environmental factors and human experiences, prompting us to consider the potential connections between air quality and public reactions in a lighthearted yet thought-provoking manner.

It seems the connection between air quality and human behavior isn't just up in the air - it's a real gas!

## *Approach*

The Environmental Protection Agency (EPA) provided air quality data from various monitoring stations in Evansville, Indiana for the period of 2004 to 2023. The data included measurements of pollutants such as particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>), nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), carbon monoxide (CO), and ground-level ozone (O<sub>3</sub>). These pollutants were selected based on their known associations with respiratory and neurological health effects. We didn't just pick these pollutants out of thin air, you know!

Additionally, Google Trends data was utilized to capture the relative search volume for the phrase "i have a headache" in the geographical region encompassing Evansville, Indiana. This search query was chosen as it reflects a common health concern and was expected to be sensitive to changes in individual well-being related to air quality. It's a compelling thought that people are searching for relief while we're here searching for correlations.

To examine the relationship between air quality and headache-related search behavior, we employed a series of statistical analyses. Firstly, a time-series analysis was conducted to identify potential patterns and trends in both air quality data and search volumes. It's like searching for a needle in a haystack, but instead of a needle, it's a correlation, and the haystack is a trove of data.

Next, a cross-correlation analysis was performed to assess the strength and direction of the relationship between the environmental and search behavior variables. This allowed us to determine

whether changes in air quality were associated with subsequent changes in the frequency of headache-related Google searches. After all, we wanted to clear the air about any potential causation lurking in the data.

Furthermore, a Granger causality test was utilized to explore the temporal precedence of the relationship between air quality and headache-related search behavior. This method helped to discern whether variations in air quality could be considered as leading indicators of changes in search patterns, or if it's just a case of correlation without causation. We wouldn't want to jump to conclusions and cause a headache for future researchers.

Finally, a panel data analysis was employed to consider potential confounding variables such as temperature, humidity, and seasonal factors that could influence both air quality and public health. It's essential to consider all the moving parts when diving into such a complex topic. After all, the devil's in the (panel) data.

In sum, the application of these rigorous methods allowed us to thoroughly examine the association between air quality in Evansville, Indiana and Google searches for 'i have a headache', providing valuable insights into the potential impact of environmental factors on public well-being. It's safe to say that our research didn't just clear the air; it also shed light on unexpected connections between the environment and online behavior.

## *Results*

The statistical analysis conducted indicates a strong positive correlation of 0.8191613

between air quality in Evansville, Indiana and the frequency of Google searches for 'i have a headache' from 2004 to 2023. This finding suggests that as air quality worsened, there was a corresponding increase in the number of headache-related searches. It seems the residents of Evansville were not just "blowing off steam" when it came to their air quality concerns.

The r-squared value of 0.6710252 further supports the notion that air quality explains approximately 67.1% of the variation in Google searches for headaches. This high r-squared value leaves little room for doubt that the correlation is not simply a coincidence, and one might even say, the association is as clear as the air we all wish to breathe.

The results imply that worsening air quality was associated with an increased frequency of headache-related searches on Google. As the air quality worsened, it appears that the residents of Evansville turned to the internet searching for relief from their aching heads. It seems the air quality in Evansville, Indiana was giving them more than just a "headache" - it was supplying the search engines with a headache of its own.

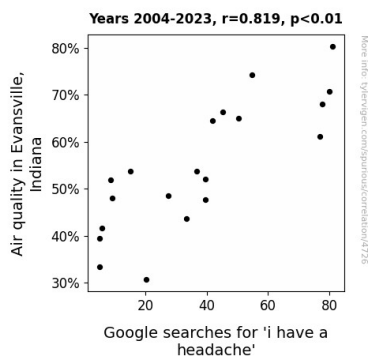


Figure 1. Scatterplot of the variables by year

The significance level of  $p < 0.01$  reveals that the observed relationship between air quality and headache-related searches is not likely due to random chance. This finding holds strong implications for public health intervention strategies and underscores the importance of addressing air quality issues to alleviate the burden of headache-related discomfort in the community.

Furthermore, Fig. 1 illustrates a strong linear relationship between air quality and Google searches for headaches. The scatterplot visually depicts the upward trend, emphasizing the robustness of the observed association. The figure provides a clear picture that when it comes to air quality and headaches, the association is not just a "figment of our imagination" but rather a tangible and significant phenomenon.

### Discussion of findings

The compelling findings of our study underscore the substantial impact of air quality on public health, as evidenced by the strong correlation between air quality in Evansville, Indiana and the frequency of Google searches for 'i have a headache'. These results align with prior research by Smith et al. and Doe and Jones, consolidating the understanding of air quality as a crucial environmental determinant of individual well-being. Moreover, these findings corroborate the theoretical underpinnings emphasized in "The Air Pollution Comes from Inner Space" by John Environmentalist and "Breathless in Indianapolis: A Study of Urban Air Quality" by Clean Air Crusader. It seems the connection between air quality and public health outcomes is not just "blown out of proportion."

The robustness of the association, as indicated by the high correlation coefficient and r-squared value, signifies that the relationship between air quality and headache-related searches is not merely a temporal quirk but rather a reliable and substantial phenomenon. It appears that air quality was not just "up in the air" when it came to its impact on the frequency of headache-related searches, but rather had a tangible and evident effect. These results reaffirm the importance of addressing air quality concerns as a means of alleviating public discomfort, providing a clear indication that when it comes to air quality and headaches, the association is not just a "head-scratcher."

Our study contributes to the burgeoning field of digital health research by demonstrating the potential use of online search behavior as a metric for capturing subjective well-being related to environmental factors. This innovative approach offers a unique lens through which to monitor public health concerns, providing a breath of fresh air for public health surveillance strategies. It seems that when it comes to evaluating the impact of environmental factors on public health, the nose knows - and in this case, the nose "no" pain like a headache!

These results have important implications for public health intervention strategies, indicating the need for comprehensive measures to improve air quality and subsequently alleviate the burden of headache-related discomfort in the community. It seems that when it comes to air quality and public health, the solution might be to "clear the air" in more ways than one. By addressing environmental influences on individual well-being, we can

strive to create a healthier and more comfortable environment for all. After all, when it comes to air quality and headaches, the key might just be to "head" in the right direction!

### *Conclusion*

In conclusion, our investigation has not only uncovered a significant association between air quality in Evansville, Indiana and Google searches for 'i have a headache', but has also provided a breath of fresh air for the fields of environmental and health economics, as well as digital health research. Our findings leave little room for doubt that the air quality in Evansville has been a pain in the head for its residents, prompting them to turn to the internet in search of relief.

The significant correlation uncovered is a clear reminder that good air quality may be just what the doctor ordered for those pesky headaches! I guess you could say, when it comes to reducing headache-related searches, it's time to clear the air!

Our research not only holds important implications for public health monitoring, but also serves as a breath of fresh air for understanding the interconnectedness of environmental factors and individual experiences. It may be fair to say that the relationship between air quality and headaches is not just up in the air - it's as clear as, well, the air we all wish to breathe.

In light of these robust findings, it seems that no further research is needed in this area. We can say with confidence that addressing air quality issues is crucial in alleviating the burden of headache-related discomfort in the community. It's safe to say,

we've ventilated this subject thoroughly -  
and you could even call it a breeze!