

# Barosinusitis due to routine weather changes: A cross-sectional analysis of public websites

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## Abstract

**Background:** Sinusitis is a common diagnosis that can be erroneously associated with routine weather-related barometric pressure changes. In actuality, these pressure changes likely exacerbate migraine headaches, which can cause facial pain and pressure rather than true sinus inflammation.

**Objective:** The present study sought to characterize the representation of both sinusitis and migraine in association with barometric pressure changes across websites on the Internet.

**Methods:** An Internet search for relevant terms was conducted, and content of the resulting pages was assessed for associations between weather-related pressure changes and either sinusitis or migraine. Variations in reported results across different subtypes of Internet sources were analyzed. The primary outcomes measured were (1) whether a given media source associated barometric weather changes with sinusitis, (2) whether that source associated barometric weather changes with migraine, and (3) treatment options offered by that source.

**Results:** Of the 116 included webpages, 36 (31.03%) associated sinusitis and routine barometric pressure changes. Of these, 10 (27.77%) were otolaryngology practice sites. Sixty-seven webpages (57.76%) associated migraine and routine barometric pressure changes. Of these, nonotolaryngology webpages were more likely to report this link.

**Conclusions:** Otolaryngology practice sites were observed to be the most frequent professional medical resource reporting the unsubstantiated claim that routine barometric pressure changes are associated with sinusitis. Nonotolaryngology sources were more likely to link weather-related pressure changes to migraine. These results suggest that opportunities exist for otolaryngology practice sites to educate patients about nonrhinogenic headache etiologies.

## KEYWORDS

acute rhinosinusitis, balloon sinus dilation, headache, migraine, sinusitis

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### Key points

- This study found that websites of otolaryngology practices most frequently reported an association between routine barometric pressure changes and sinusitis, while nonotolaryngology sources were more likely to correctly link these pressure changes to migraine.
- These findings suggest that public otolaryngology resources can improve in the delivery of accurate and diagnostically helpful information to patients.

## INTRODUCTION

Sinusitis is one of the most common diagnoses in primary care, affecting about 30 million adults in the United States each year.<sup>1</sup> This diagnosis carries a significant disease burden with high associated health care costs,<sup>2,3</sup> and accounts for more antibiotic prescribing in the United States than any other diagnosis.<sup>4</sup> Despite its prevalence, there is evidence that the general population tends to have a poor understanding of the pathophysiology of sinusitis.<sup>5</sup> Therefore, analyzing the public's perception of sinusitis can provide important insights for physicians who are tasked with counseling their patients as well as the general public on this condition.

The Internet has undoubtedly changed the way patients approach health-related information. While health-related misinformation has been a longstanding issue before the existence of the Internet,<sup>6</sup> the digital age has allowed for the inexpensive, wide, and rapid dissemination of information, both good and bad, at exponentially increasing rates. Recently, patients and caregivers have both been found to increasingly turn to the Internet for their health questions.<sup>7,8</sup> In relation to sinusitis, there is evidence that information available online is often lacking in quality, readability, and reliability.<sup>9,10</sup>

One common misconception that patients have centers around the relationship between weather changes and sinusitis. More specifically, a widely held belief is that routine barometric pressure changes—including warm fronts and cold fronts—can cause sinusitis. While true barosinusitis is seen with large fluctuations in barometric pressure (e.g., diving, flying),<sup>11</sup> there is no evidence to support the notion of barosinusitis from routine weather changes.<sup>12,13</sup> Rather, the facial pain and pressure that patients experience with weather changes are likely migraine-related.<sup>14-17</sup> However, patients with these nonrhinogenic headaches often carry self- or physician-made diagnoses of sinusitis, leading to ineffective and imprudent treatments such as antibiotic therapy, balloon dilation, and endoscopic sinus surgery.<sup>18,19</sup> The present study sought to characterize online information pertaining to the association between sinusitis and routine barometric pressure changes.

## METHODS

The Google search engine (Google LLC) was queried in September 2021 with three search terms: "sinusitis weather," "sinus barometric pressure," and "weather pressure headache." The first 50 websites for each search term were gathered. Searches were conducted in "incognito" mode, with location tracking disabled to avoid search engine modifications based on prior user preferences and searches. Duplicate websites and pay-to-access sites were removed, and the remaining webpages were analyzed and ranked by two independent reviewers. Information pertaining to the following was collected for each site: webpage type (e.g., medical practice, media site, professional society, etc.), domain extension (e.g., .com, .org, .gov, etc.), and medical specialty involved. Media sources included news outlets and public blogs. Reviewers also assessed to what extent each site reported an association between routine barometric pressure changes and sinusitis as well as routine barometric pressure changes and migraine, by assigning each to one of three categories: (1) no association stated or implied, (2) association implied, (3) association clearly stated. For sites that implied or stated a relationship between routine barometric pressure changes and sinusitis, reviewers recorded any treatment options that were offered. Websites with disparate rankings by the two reviewers were assessed by the senior author for a final score. Pearson's  $\chi^2$  univariate tests were utilized, with a  $P < 0.05$  considered statistically significant. Analysis was performed in JMP Pro (version 16.0.0; SAS Institute Inc).

## RESULTS

Characteristics of the webpages included in the study are shown in Table 1. A total of 116 sites were identified after removal of duplicates and removal of 10 sites requiring payment to access. More than half (54.31%) were news or media sites and close to a third (32.00%) were medical practice websites, with the majority (59% of medical practice sites) being otolaryngology practices. The majority (81.03%) had a .com domain extension.

**TABLE 1** Webpage characteristics (n = 116).

Website type	116 (100.00%)
Media (news website, blog, etc.)	63 (54.31%)
Otolaryngology practice	22 (18.97%)
Other medical practice	15 (12.93%)
Other (e.g., journal publication, advertisement)	8 (6.90%)
Device or pharmaceutical company	5 (4.31%)
Professional society	3 (2.59%)
Specialty (if practice website)	37 (31.90% of total)
Otolaryngology	22 (59.46%)
Health systems	8 (21.62%)
Allergy	3 (8.11%)
Neurology	2 (5.41%)
Pain	2 (5.41%)
Medical expert featured on media site	36 (31.03% of total)
Primary care	11 (30.56%)
Neurologist	8 (22.22%)
ENT	7 (19.44%)
PhD	4 (11.11%)
Chiropractor	2 (5.56%)
Allergist	1 (2.78%)
Multiple	1 (2.78%)
Ophthalmologist	1 (2.78%)
Psychologist	1 (2.78%)
Domain extension type	116 (100.00% of total)
.com	95 (81.89%)
.org	11 (9.48%)
.gov	3 (2.59%)
.edu	2 (1.72%)
.uk	2 (1.72%)
.net	1 (0.86%)
.jp	1 (0.86%)
.ca	1 (0.86%)

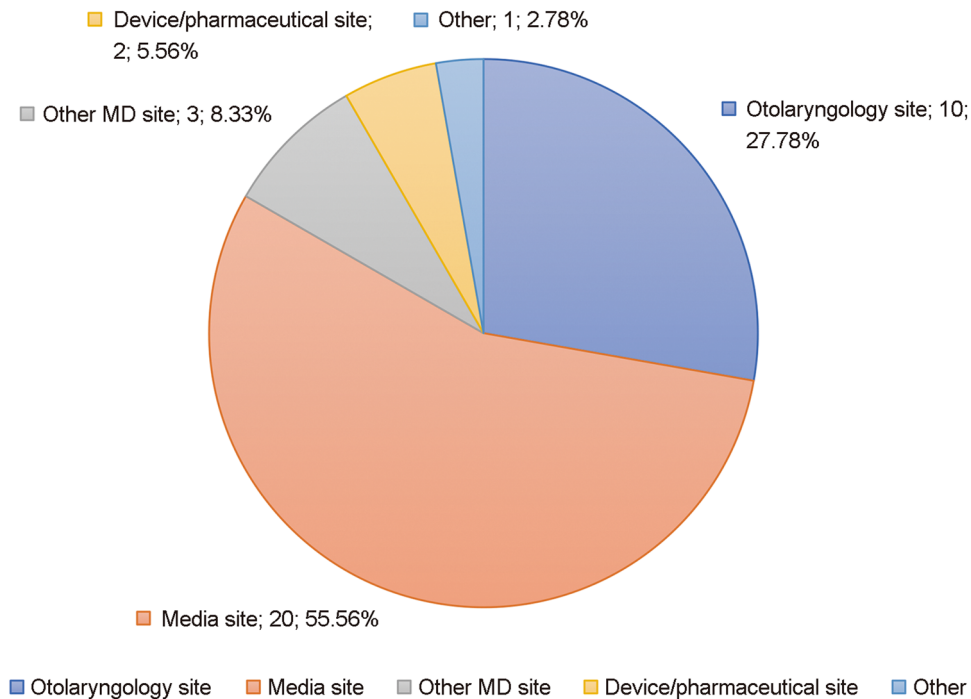
Of the included webpages, 24 (20.69%) clearly stated there was a causative relationship between routine barometric pressure changes and sinus inflammation, 12 (10.34%) inferred such a link, and 80 (68.97%) made no such claim or inference on the subject. Of the 36 websites that stated or implied that there was an association between sinusitis and routine barometric pressure change, 10 of these (27.77%) were otolaryngology practice sites and 20 (55.55%) were media sites (Figure 1).

Three (2.59%) pages clearly stated a link between routine barometric pressure changes and migraine, 64 (55.17%) implied such a link, and 49 (42.24%) made no such claim or inference on the subject. Findings are summarized in Table 2. Of the 67 websites that stated or implied that there was an association between barometric pressure change and migraine, 43 (64.18%) were media sites. Twenty-three of these media sites featured an expert that was either quoted or interviewed on the subject. Seventeen featured a primary care physician or neurologist, but only one featured an otolaryngologist (Figure 2). Twelve out of the 67 (17.91%) were medical practice websites. Only 3 of these 12 (25.00%) practice websites were otolaryngology practice websites. Nonotolaryngology sites were more likely to associate these conditions ( $P < 0.001$ ).

## DISCUSSION

The claim that routine barometric pressure changes can lead to sinus inflammation due to pressure differentials between the sinuses and atmosphere is unsubstantiated. This is in contrast to true barosinusitis due to severe pressure differentials (e.g., diving, flying), which is well-documented.<sup>11</sup> Rather, there is strong evidence to suggest that migraines are the cause of the sinus pressure and discomfort experienced during weather changes.<sup>17,20,21</sup> However, this study demonstrates that medical experts on the Internet, including otolaryngologists, regularly perpetuate the unsubstantiated claim that routine barometric pressure changes cause sinus inflammation. Moreover, we found that some otolaryngology practice websites we reviewed promoted balloon sinus dilation as a treatment for this supposed entity despite evidence to the contrary, including the landmark study by Laury et al.<sup>19</sup> On the other hand, the medical experts significantly associated with websites that accurately attributed sinus headache and pain to migraine-related pathophysiology were primary care physicians and neurologists.

Our results suggest two potential opportunities for education and quality improvement as they relate to Internet content. The first is the education of the otolaryngology community. While our study does not assess the prevalence of unsubstantiated or false information on otolaryngology practice websites as a whole, the majority of the first 20 websites generated by the search engine were otolaryngology practice websites that purported the concept of routine weather barosinusitis and offered interventional treatments for it. Because sites listed first likely encounter the most traffic, misinformation can easily be perpetuated by the otolaryngology community. Otolaryngologists have a responsibility to critically assess their web content by reviewing the evidence and refrain from offering nonevidence-based treatments. Moreover, the omission of migraine as a cause for sinus pressure caused by routine barometric changes is a more subtle, albeit important, form of misinformation that must be remedied.



**FIGURE 1** Sites that stated or implied a link between sinusitis and barometric pressure changes.

**TABLE 2** Webpage content (n = 116).

Link between routine barometric pressure changes and sinusitis	n (%)
Explicitly stated	24 (20.69)
Implied	12 (10.34)
Not mentioned	80 (68.97)
<i>Link between routine barometric pressure changes and migraine</i>	
Explicitly stated	3 (2.59)
Implied	64 (55.17)
Not mentioned	49 (42.24)

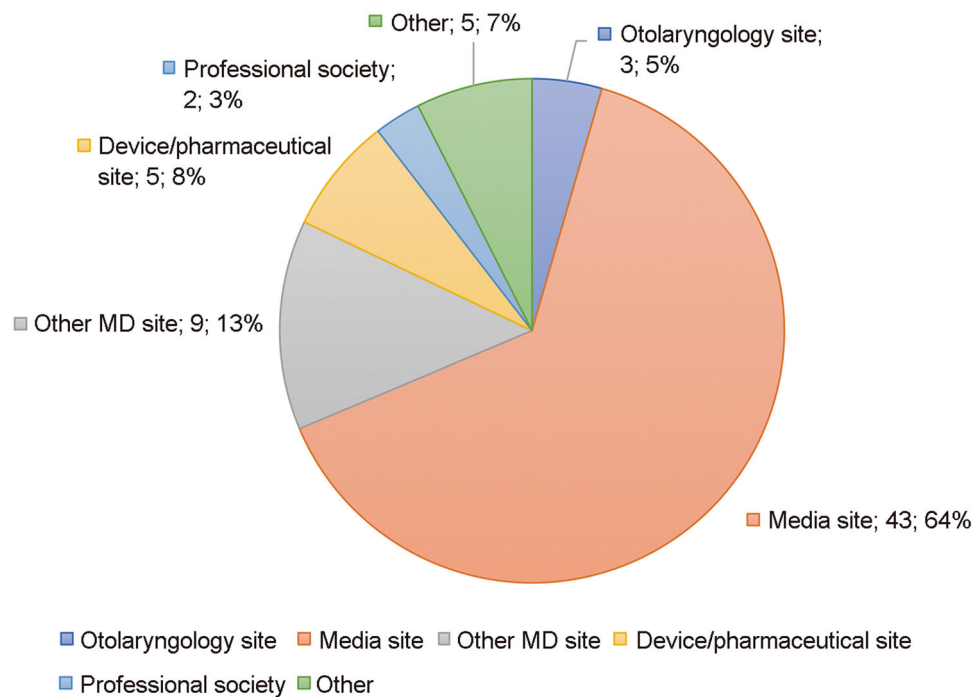
A second potential area of education centers around the patient, as patients will often diagnose themselves with sinusitis when experiencing nonrhinogenic facial pain or pressure. One study revealed that patients carry this false diagnosis for a mean of 7 years before the correct diagnosis of migraine is made.<sup>22</sup> In these situations, the onus often falls on the otolaryngologist to educate and re-direct patients to the appropriate treatment path; this correction is often made late in a patient's symptomatic course. The wide dissemination of accurate patient-facing resources can prevent patients from misdiagnosing themselves and trialing ineffective remedies, thus helping them receive the proper treatment sooner.

This study has limitations. The initial search for websites was performed without location tracking, and websites garnered by

the search engine could potentially vary significantly depending on a patient's location, which could decrease the external validity of our study. Additional studies would be required to validate our findings. Nonetheless, the included websites have a high number of visitors and included various domain types, thereby suggesting these findings are not isolated. In addition, it is possible that personal bias, including reviewer opinion, was involved in the website analysis process; while the use of two reviewers attempted to reduce this risk, these biases still might exist. Further, websites that were inaccessible to either or both reviewers, (e.g., due to paywalls and subscriptions) were eliminated from the analysis; this might have made the present data set slightly less representative of the media available on the internet as a whole. Finally, our study queried only three search terms, which would not completely capture websites that patients could find with other search terms. Despite these limitations, we believe this study demonstrates a significant issue in the way that weather-related facial pressure or headaches are represented to the lay public and points to an area for potential improvement in physician communication with patients.

**CONCLUSION**

This study found that the unsubstantiated claim of routine barometric pressure changes causing sinus disease was most frequently found on otolaryngology practice websites. In contrast, nonotolaryngology sources were more likely to contain



**FIGURE 2** Sites that stated or implied a link between migraine and barometric pressure changes.

information linking sinus headache to migraine among medical practice websites. These findings point to an opportunity to educate health care practitioners regarding nonrhinogenic headache and sinusitis, and encourage the medical community to continue to promote evidence-based practices.

#### AUTHOR CONTRIBUTION

*Concept and design:* James C. Campbell, Julia E. Canick, Philip G. Chen, Ralph Abi Hachem, and David W. Jang. *Acquisition, analysis, and interpretation of the data:* James C. Campbell, Julia E. Canick, and David W. Jang. *Drafting of the manuscript:* James C. Campbell and Julia E. Canick. *Critical revision of the manuscript for important intellectual content:* James C. Campbell, Philip G. Chen, Ralph Abi Hachem, and David W. Jang. *Statistical analysis:* James C. Campbell and David W. Jang. *Supervision:* Philip G. Chen, Ralph Abi Hachem, and David W. Jang. James C. Campbell, Julia E. Canick, Philip G. Chen, Ralph Abi Hachem, and David W. Jang had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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#### CONFLICTS OF INTEREST STATEMENT

David Jang and Ralph Abi Hachem receive research funding from Amgen and GlaxoSmithKline. David Jang is a consultant for Medtronic. Philip Chen is a consultant for Integra and Medtronic and is on the speaker's bureau for GlaxoSmithKline.

#### DATA AVAILABILITY STATEMENT

The data that support the findings in this study are openly available on the included websites. The aggregate data are available from the corresponding author upon reasonable request.

#### ETHICS STATEMENT

N/A.

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