Google Searches for Otologic Symptoms Fluctuate by Season

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Introduction

- Vestibular dysfunction is prevalent within the United States[1] and is commonly attributed to dysfunction in vestibular systems or neuromuscular pathways.[2]
- Seasonal-dependent frequency of otologic and vestibular symptoms has been reported but is poorly understood.[3]
- Many otologic or vestibular symptoms conform to a seasonal pattern, peaking during specific months.[4]
- For example, benign paroxysmal positional vertigo is more common in early spring or cold seasons, possibly linked to vitamin D deficiencies.[5] Epistaxis is most common in winter or fall seasons.[6]
- Allergic rhinitis cases appeared to peak in September with cases waning by July.[7] Conversely, vertigo was most frequent from August to November.[8]
- Search interest for terms can be abstracted using Google Trends, an online database that provides public interest in a topic. This relative search interest can be analyzed for patterns and trends.
- Google Trends data has immense applications in data science and has been used to understand the seasonal trends in the incidence of rhinosinusitis[9] and epistaxis.[10]
- No studies so far have broadly investigated seasonal trends in vestibular and cochlear symptoms. The aim of this study is to understand whether these symptoms are more frequent in particular seasons or display cyclicality.

Methods

- Search interest for 13 terms, including “tinnitus,” “vertigo,” and “headache” were queried through Google Trends. Web searches within the United States were excluded, with low search volume regions omitted to reduce noise.
- Months were categorized into seasons: Winter was December to February; Spring was March to May; Summer was June to August, and Autumn was September to November.
- Mann-Whitney U testing was used, comparing each season relative to the remainder of the year.
- Comparative analysis was conducted in R version 4.3.0, with $p<0.05$ marking significance.

Conclusions

- Winter and Autumn months saw cochlear symptoms peak, likely due to pressure changes.
- The tympanic membrane is sensitive to pressure fluctuations, resulting in migraine-related symptoms.
- Similar trends between cochlear symptoms and migraine or migraine headache suggest a mechanistic associated, rooted in the tympanic membrane’s function as an anatomic pressure sensor.

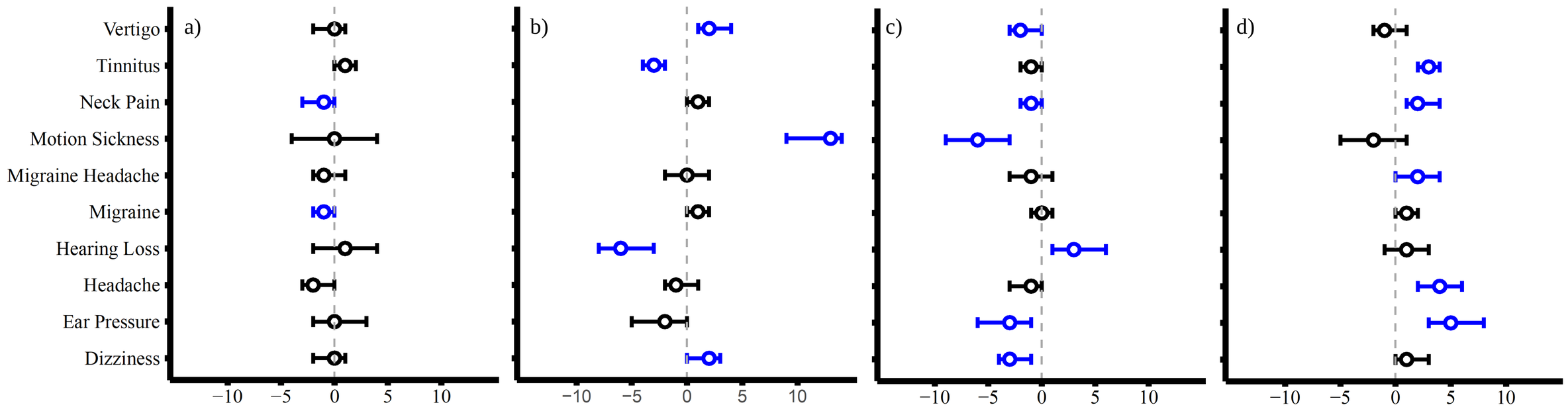
Symptom	Spring	Summer	Autumn	Winter
Dizziness		ρ=0.135	ρ=-0.185	
Ear Pressure			ρ=-0.160	ρ=0.243
Headache				ρ=0.235
Hearing Loss		ρ=-0.284	ρ=0.170	
Migraine	ρ=-0.156			
Migraine Headache				ρ=0.120
Motion Sickness		ρ=0.330	ρ=-0.235	
Neck Pain	ρ=-0.156		ρ=-0.128	ρ=0.218
Tinnitus		ρ=-0.308		ρ=0.281
Vertigo		ρ=0.182	ρ=-0.128	

Table 1. Effect sizes of statistically significant changes, with Cohen’s r values (ρ) reported. Blue boxes signify peaks and yellow shading indicates dips in interest. Greater ρ values indicate larger magnitudes of change.

Results

- Two terms showed significant differences for Spring; small declines in search interest were observed in neck pain (p=0.008, ρ=-0.156) and migraine (p=0.008, ρ=-0.156).
- In the Summer, seven terms showed significant changes. Motion sickness (p<0.001, ρ=0.330) exhibited a moderate increase in searches, with vertigo (p=0.002, ρ=0.182) and dizziness (p=0.024, ρ=0.135) posting small increases.
- Moderate decreases in search interest were detected tinnitus (p=<0.001, ρ=-0.308).
- Hearing loss (p<0.001, ρ=-0.284) posted small declines.
- During Autumn months, seven terms exhibited significant variations in search interest. Small rises in search interest were noted for hearing loss (p=0.005, ρ=0.170).
- Motion sickness (p<0.001, ρ=-0.235), dizziness (p=0.002, ρ=-0.185), ear pressure (p=0.008, ρ=-0.160), vertigo (p=0.033, ρ=-0.128), and neck pain (p=0.032, ρ=-0.128) had small decreases in search interest.
- In Wintertime, six terms showed significance, with search interest trending upwards for all terms.
- Small increases were seen for tinnitus (p<0.001, ρ=0.281), ear pressure (p<0.001, ρ=0.243), headache (p<0.001, ρ=0.235), neck pain (p<0.001, ρ=0.218), and migraine headache (p=0.042, ρ=0.12).

Figure 1. Forest plot showing mean difference for each term for a) spring, b) summer, c) autumn, and d) winter months compared to the rest of the year. Points represent the average differences in relative search interest, with bars signifying 95% confidence intervals and blue coloring representing statistically significant differences.



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