New Insights into Migraine-Related Ear Symptoms from the Headache, Ear, Auditory, Dizzy, and Sinus (HEADS) Registry

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BACKGROUND

- Increased clinical awareness and familiarity with vestibular migraine have offered a new explanation for many forms of balance and vertiginous symptoms. However, there exist lesser-known variants associated with the auricular and auditory sensory systems.
- The current literature has described a limited number of otologic symptoms associated with migraine, including observations of relationships between fluctuating or sudden sensorineural hearing loss (1) and tinnitus (2).
- These relationships have the potential to redefine the role migraine disease plays in affecting the normal function of the auditory nervous system.
- We examined the association between migraine and a wide range of sensory symptoms of the middle and external ear, extending beyond the current literature.

METHODS

- The HEADS Registry is a prospective, patient-reported set of questions (available in English and Spanish) deployed through a web-based portal.
- From July 2023 to September 2024, participants in the HEADS registry were recruited through a variety of means, including their medical professionals, the registry sponsor's contact channels, social media, and partnerships with nonprofit organizations.
- Inclusion criteria: having head and/or neck symptoms, including headache, rhinosinusitis (chronic or recurring), and dizziness. Other inclusion criteria: residing in the United States, aged ≥18 yrs, and understanding English or Spanish.
- The validated, self-reported ID Migraine screening tool was used to identify individuals with high likelihood of migraine (3).
- To examine the association between migraine and otologic symptoms, the prevalence of otologic sensory and special sensory symptoms (tinnitus and central auditory processing disorder) were compared between those who met ID Migraine screening criteria (ID Migraine +) vs those who did not (ID Migraine -), controlling for age and gender.
- Categorical data were compared using chi-square or Fisher's exact test. Continuous data were compared using an independent samples t-test. Logistic regression was used for multivariate analysis.

RESULTS

- Among 686 registrants, the majority were Caucasian (91.5%) and female (90.2%).
- 81.0% met criteria for ID Migraine +. Compared to ID Migraine -, ID Migraine + was younger (49.3±15.2 vs 59.0±15.2, *P*<.001) and had more females (93.7 vs 75.4%, *P*<.001).

Table 1. Headache History: ID Migraine Negative versus ID Migraine Positive Groups

Variable	ID Migraine – (*n*=130)	ID Migraine + (*n*=556)	Total (*N*=686)	X^2	*P*
Headache limited activities for ≥1d in last 3mo	39 (30.0)	536 (96.4)	575 (83.8)	341.98	<.001
Frequent or severe headaches at any time in life	82 (63.1)	556 (100.0)	638 (93.0)	220.74	<.001
Light sensitivity occurs with headache	16 (12.3)	530 (95.3)	546 (79.6)	447.04	<.001
Nausea or vomiting occurs with headache	2 (1.5)	443 (79.7)	445 (64.9)	282.29	<.001

Figure 1. Number of Otologic Symptoms

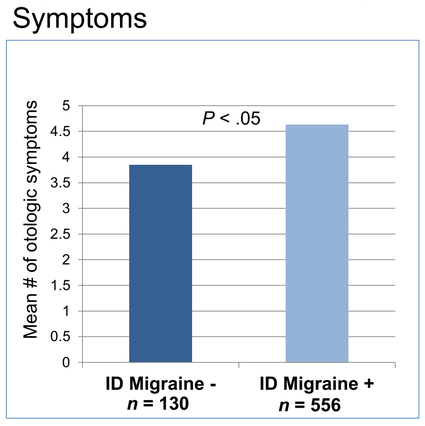
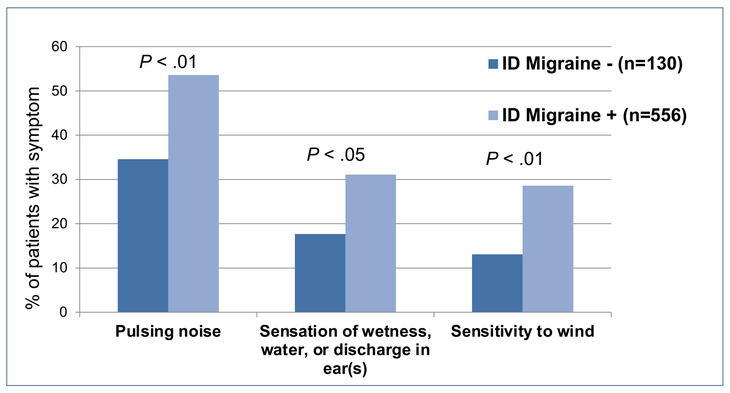


Figure 2. Novel Otologic Symptoms



- *Otologic Symptoms*: Adjusting for age and gender, ID Migraine+ had greater prevalence of tinnitus, pulsing noise, sensation of wetness, water, or discharge in their ear(s), sensitivity to wind (Figure 2 and Table 2), and mean number of auditory symptoms (Figure 1).

RESULTS

Table 2. All Otologic Symptoms: ID Migraine Negative versus ID Migraine Positive Groups

Variable	ID Migraine – (n=130)	ID Migraine+ (n=556)	Total (N=686)	X^2	*P*	Adjusted *P* *
Sounds not as loud or absent	48 (36.9)	181 (32.6)	229 (33.4)	0.90	.342	.721
Can hear sounds but difficult to understand	62 (47.7)	252 (45.3)	314 (45.8)	0.24	.626	.915
Tinnitus	94 (72.3)	437 (78.6)	531 (77.4)	2.38	.123	.045
Pulsing noise	45 (34.6)	298 (53.6)	343 (50.0)	15.19	<.001	.005
Thumping noise	12 (9.2)	82 (14.7)	94 (13.7)	2.71	.100	.365
Sensation of wetness, water, or discharge in ear(s)	23 (17.7)	173 (31.1)	196 (28.6)	9.30	.002	.035
Sensation of something in ear(s)	28 (21.5)	148 (26.6)	176 (25.7)	1.43	.232	.348
Sensitivity to wind	17 (13.1)	159 (28.6)	176 (25.7)	13.31	<.001	.003
Unexplained pressure or ear blockage sensation	59 (45.4)	257 (46.2)	316 (46.1)	0.03	.863	.799
Ear pain	48 (36.9)	260 (46.8)	308 (44.9)	4.12	.042	.650
Ear canals are sensitive to touch	14 (10.8)	74 (13.3)	88 (12.8)	0.61	.436	.861
Popping or crackling	42 (32.3)	222 (39.9)	264 (38.5)	2.59	.108	.295
Number of otologic symptoms, mean±SD	3.85±2.47	4.63±2.57	4.48±2.57	-1.28, -0.30	.002	.016

Note. X^2 = chi-square statistic; Number of otologic symptoms statistic is 95% confidence interval. *Adjusted for age and gender

Findings from additional otologic symptom details:

- ID Migraine + had higher rate of sudden loss of hearing (17.8 vs 10.0%, *P*=.030) and hearing improvement after sudden loss of hearing (26.3 vs 17.7%, *P*=.041).
- ID Migraine + had higher rate of difficulty understanding conversations at a younger age (26-40 yr range: 17.4 vs 6.9%, *P*<.05), despite a higher normal hearing test rate (62.0 vs 45.9%: *P*<.05).
- ID Migraine + had higher rates of tinnitus occurring intermittently (65.1 vs 49.2%, P<.001), constantly for others (23.6 vs. 13.8%, P<.014), and associated tinnitus with discomfort/pain (54.0 vs 36.2%, P<.001), anxiety (63.1 vs 34.6%, P<.001), fear/avoidance (22.1 vs. 10.0%, P=.002), dizziness/imbalance (26.8 vs 13.8%, P<.001), nausea (26.8 vs 13.8%, P<.001), light sensitivity (41.4 vs 12.3%, P<.001), smell sensitivity (25.2 vs 3.1%, P<.001), and headache (48.4 vs 17.7%, *P*<.001).
- ID Migraine + had higher prevalence of headache associated with ear symptoms sometimes (38.5 vs 28.5%, *P*<.05) and often (36.2 vs 14.6%, *P*<.05).

DISCUSSION

- Migraine has been marked by headache pain or its effect on the trigeminal nerve; however, these data report an association between migraine and several symptoms of the external, middle, and inner ear.
- Of particular interest, we found *novel* associations with migraine, including sensation of wetness, water, or discharge in one or both ears, sensitivity to wind, and pulsing noise.
- These associations reinforce the concept that migraine affects multiple cranial nerves (CN V, CN VII, CN IX and CN X) and the special sensory network of the auditory nerve (Figures 3 and 4).

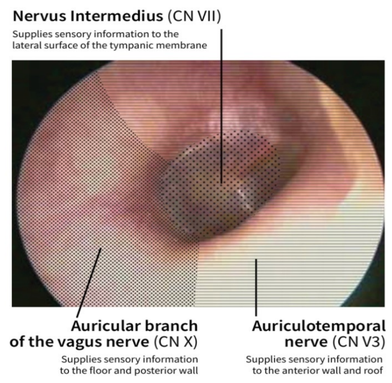


Figure 3. Sensory innervation of the ear canal. The auriculotemporal nerve (a branch of the mandibular nerve–CN V3) innervates the anterior wall and roof of the ear canal. The auricular branch of the vagus nerve (CN X) contributes to the floor and posterior wall. The nervus intermedius (a branch of the facial nerve–CN VII) innervates the lateral surface of the tympanic membrane and contributes to the ear canal.

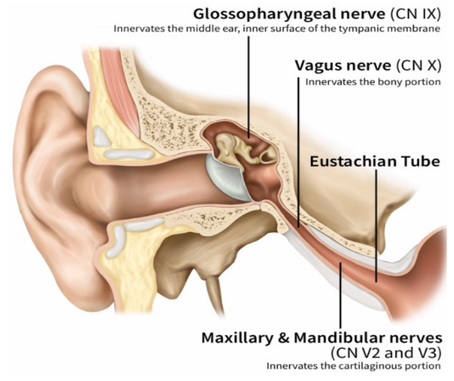


Figure 4. Sensory Innervation of the middle ear structures. The glossopharyngeal nerve (CN IX) innervates the middle ear, inner surface of the tympanic membrane and bony portio n of the eustachian tube (ET). The Vagus nerve (CNX) contributes to the bony portion of the ET. The trigeminal nerve (CN V2 and V3) innervates the cartilaginous portion of the ET.

DISCUSSION

- These data suggest that migraine is associated with several general and special sensory nervous systems of the ear. Specifically, we found that migraine is associated with malfunctions of the auditory nervous system.
- We also identified novel symptoms that may be associated with migraine, including pulsing noise, sensation of wetness, water, or discharge in one or both ears, and sensitivity to wind.
- These novel findings deserve further study in rigorously designed studies.

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